A Data-Driven Approach to Managing Human Factors within the Mining Industry

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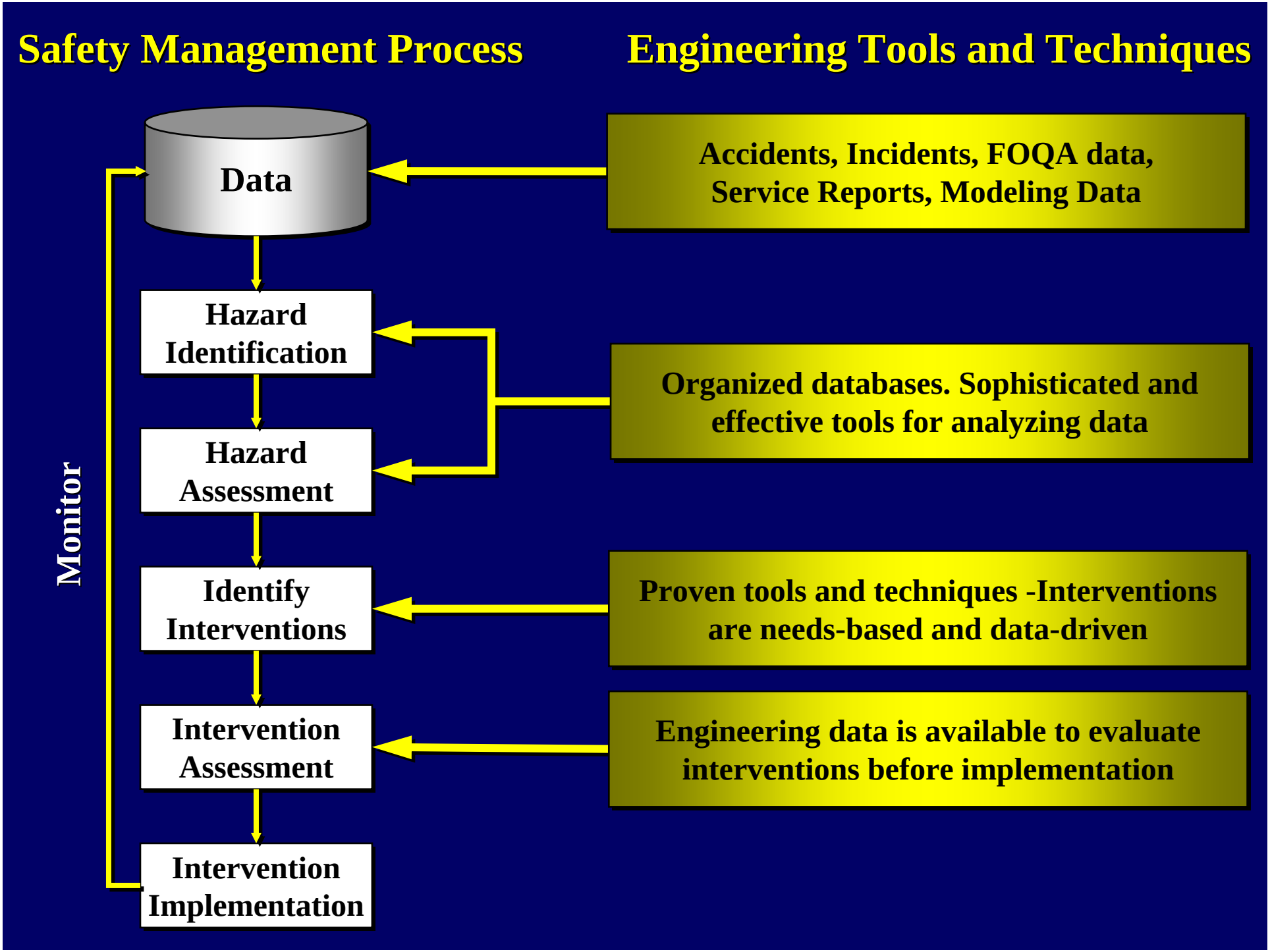
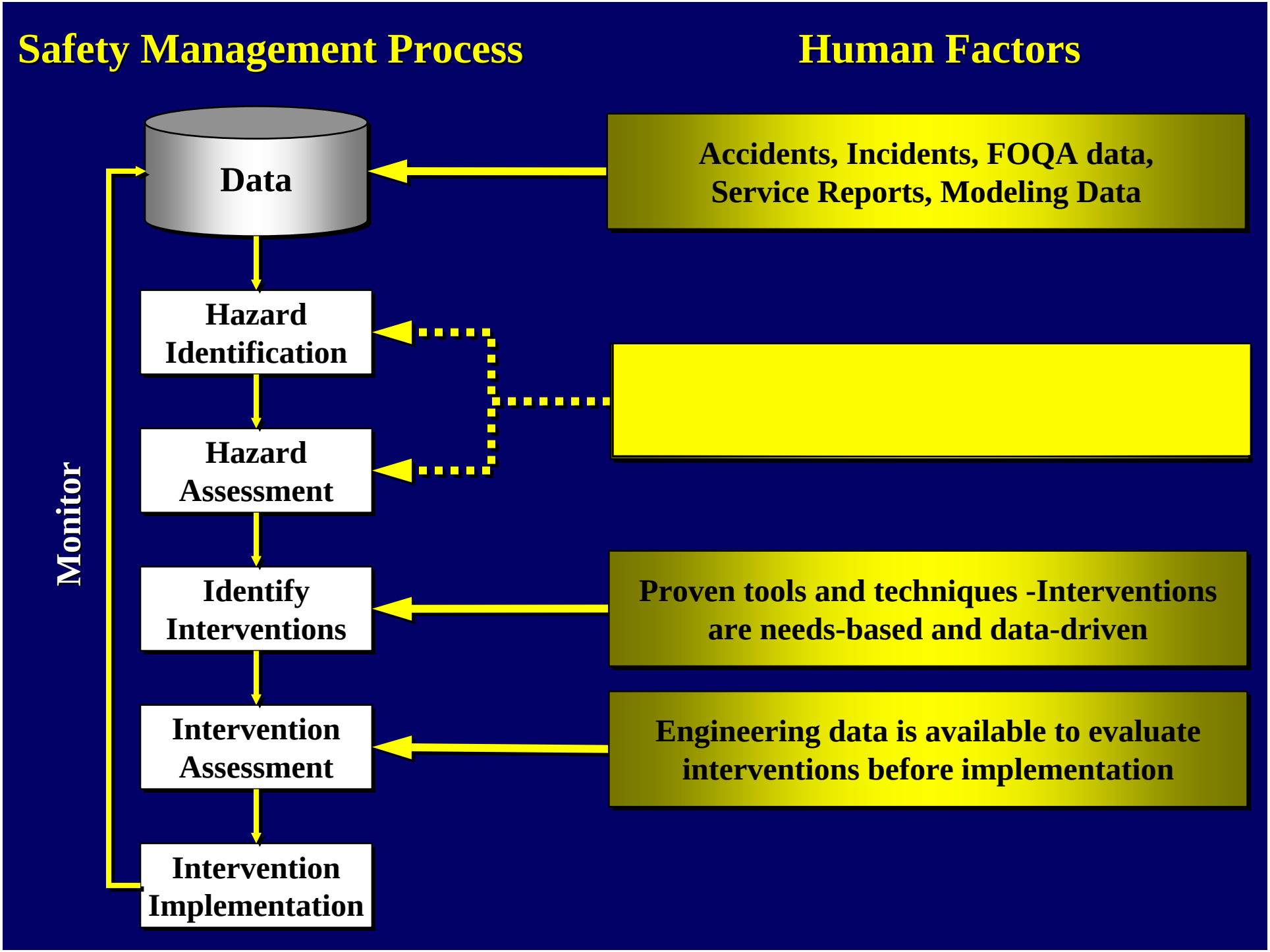
Professor
Clemson University
Department of Industrial Engineering

MISTAKES

It Could Be that the Purpose of Your Life Is
Only to Serve as a Warning to Others.


Safety Management Process
Engineering Tools and Techniques
Data
Accidents, Incidents, FOQA data, Service Reports, Modeling Data
Hazard Identification
Hazard Assessment
Organized databases. Sophisticated and effective tools for analyzing data
Identify Interventions
Proven tools and techniques -Interventions are needs-based and data-driven
Intervention Assessment
Engineering data is available to evaluate interventions before implementation
Intervention Implementation
Monitor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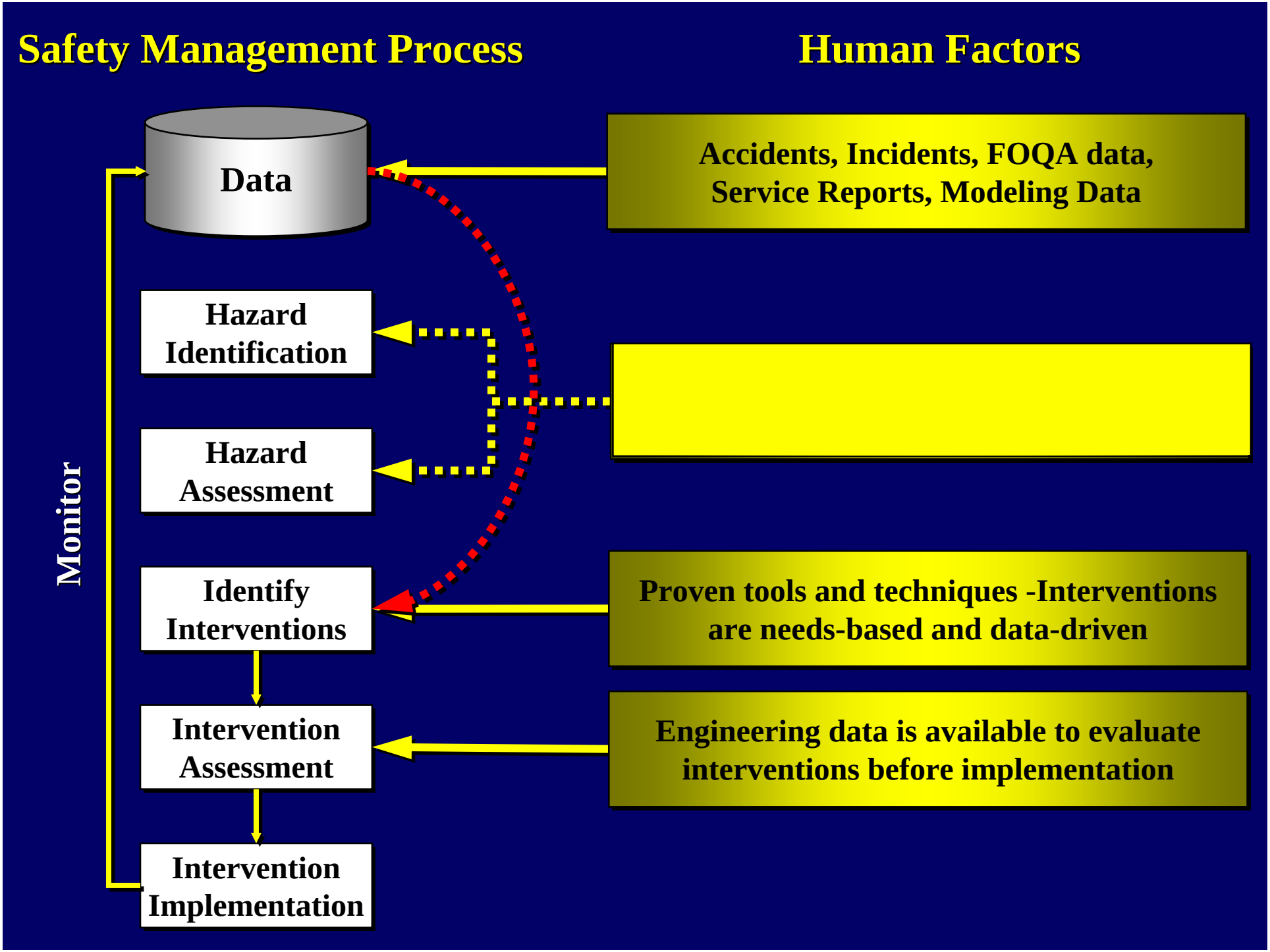
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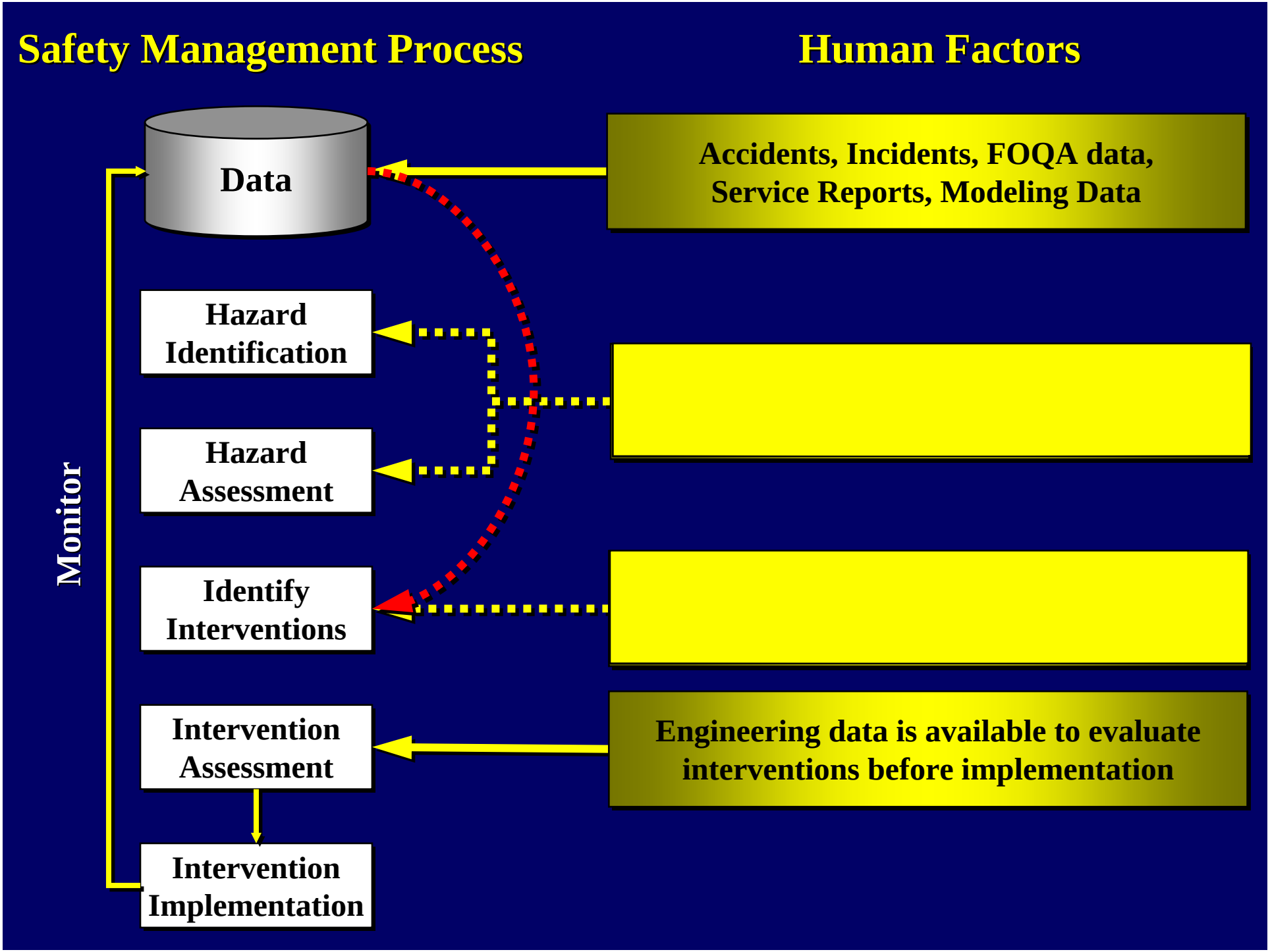
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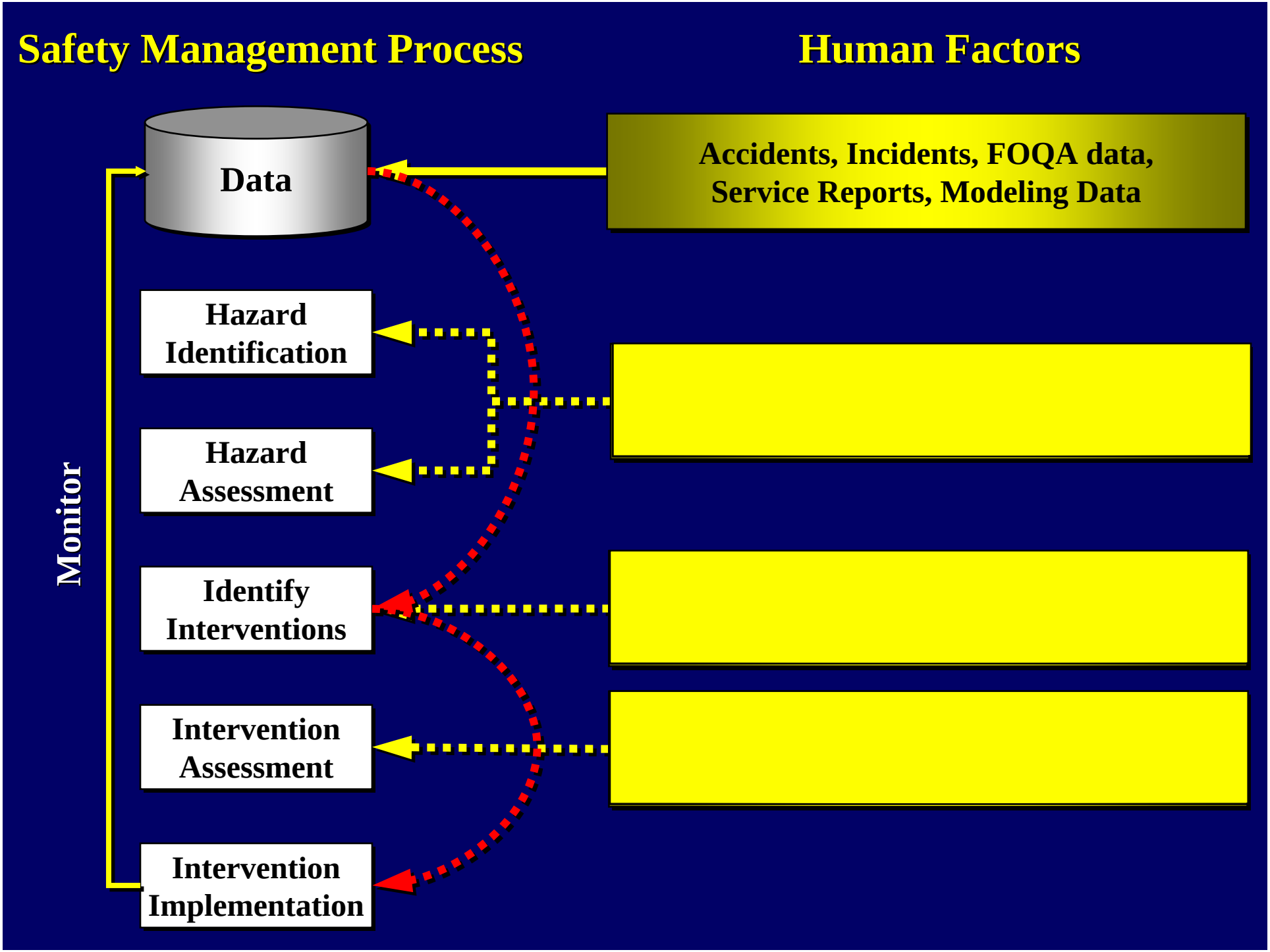
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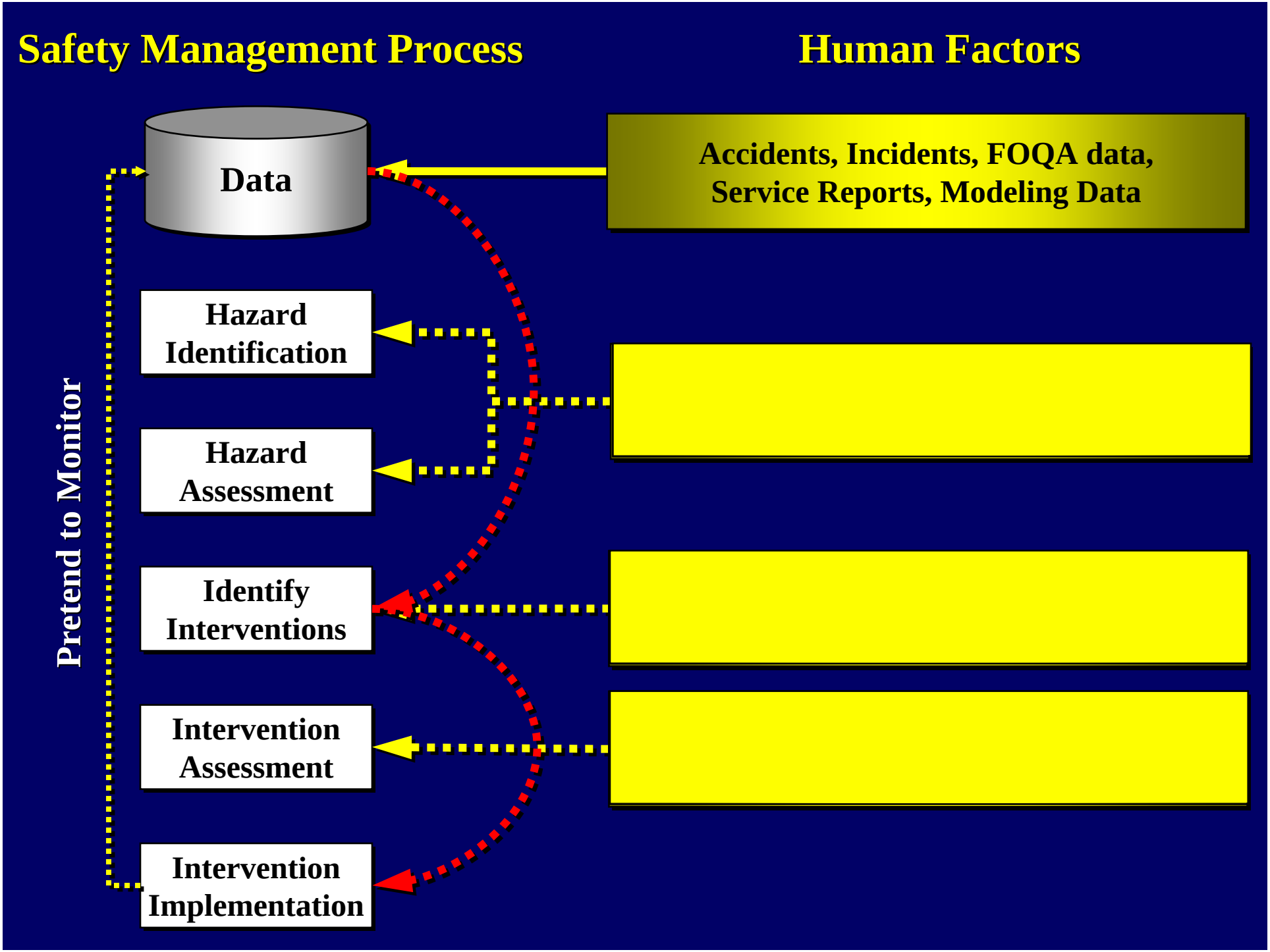
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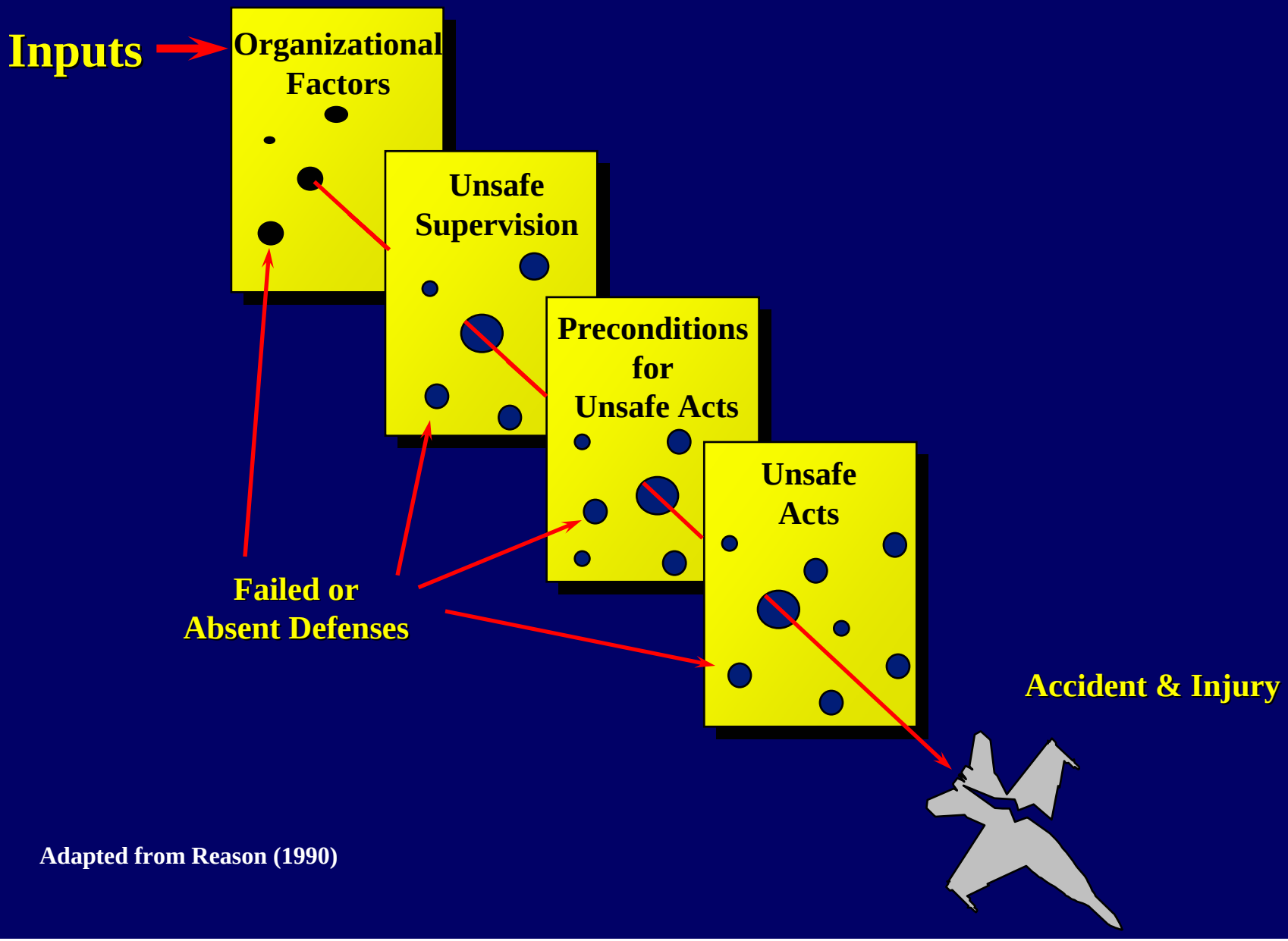
Pretend to Monitor

"Swiss-cheese" Model of Human Error



Adapted from Reason (1990)

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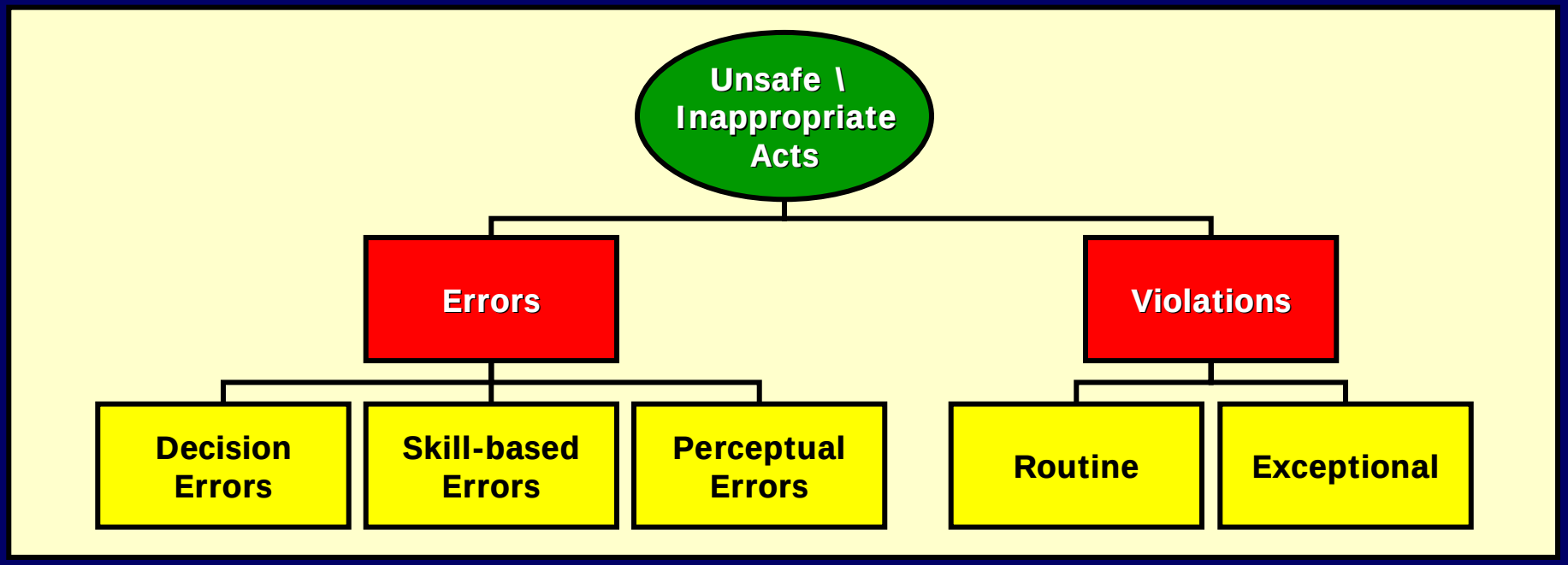
Human Factors Analysis and Classification System



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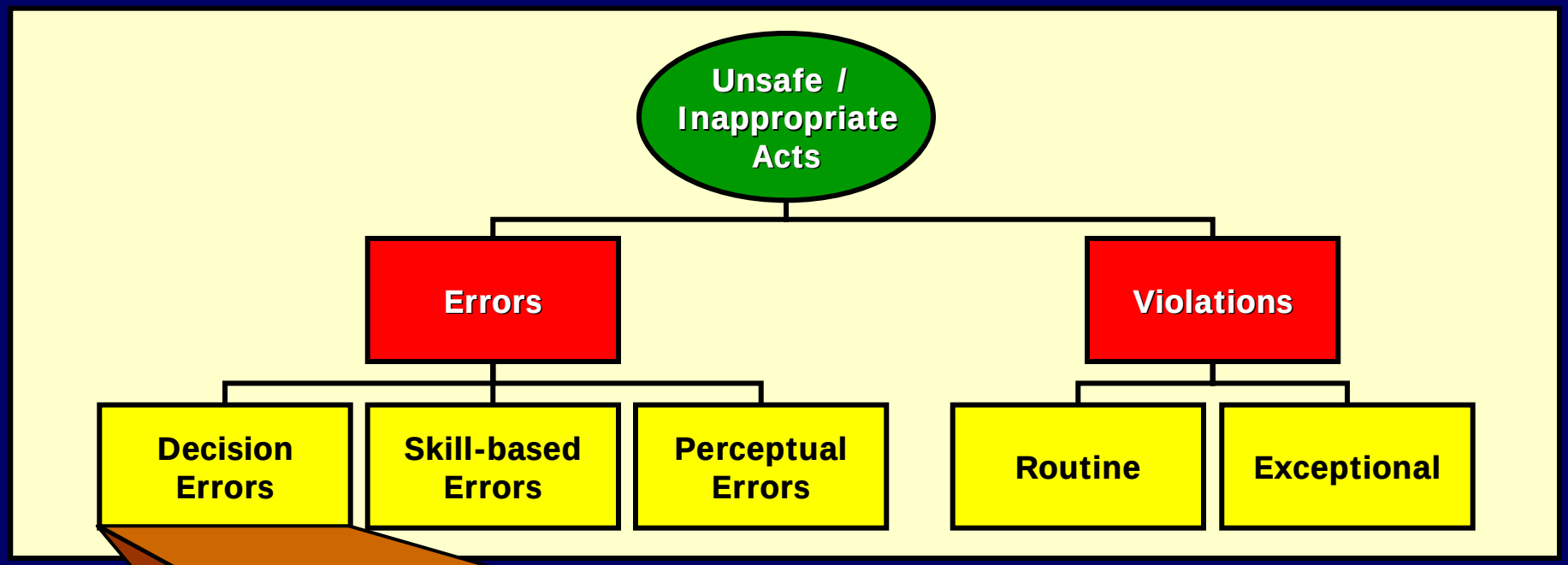

DECISION ERRORS

- Rule-based Decisions
- Choice Decisions
- Ill-Structured Decisions

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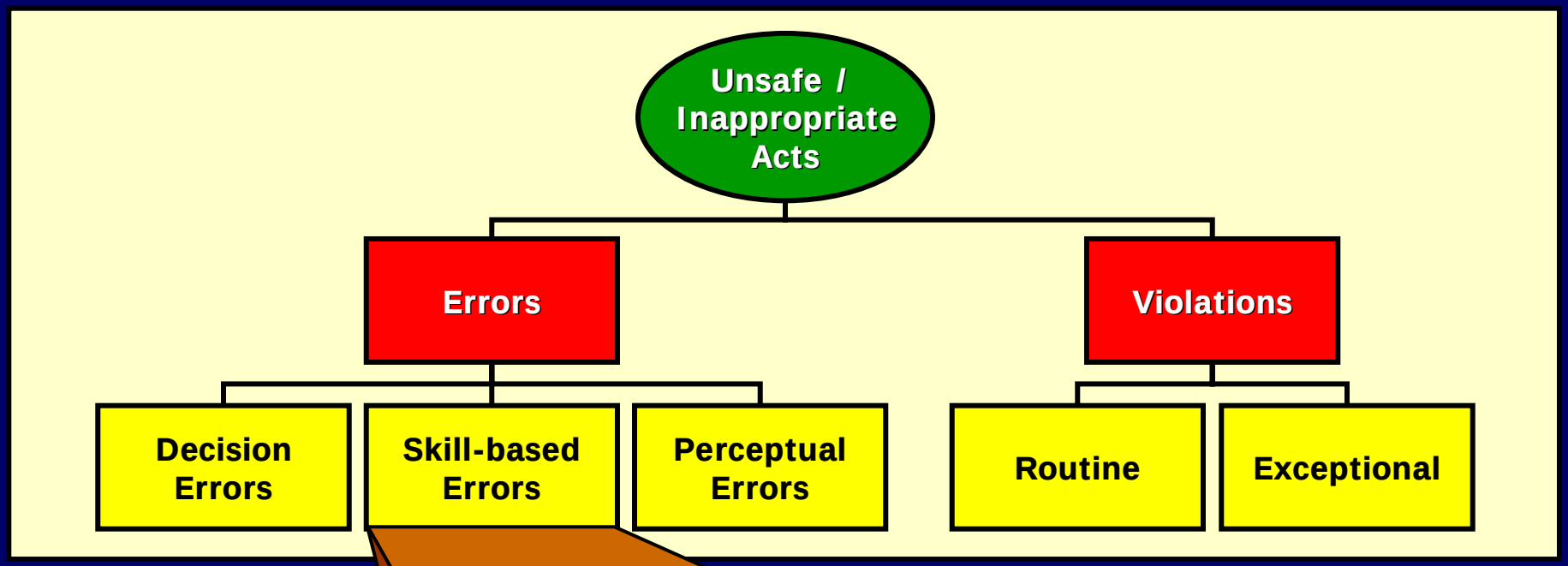

SKILL-BASED ERRORS

- Attention Failures
- Memory Failures
- Technique Errors

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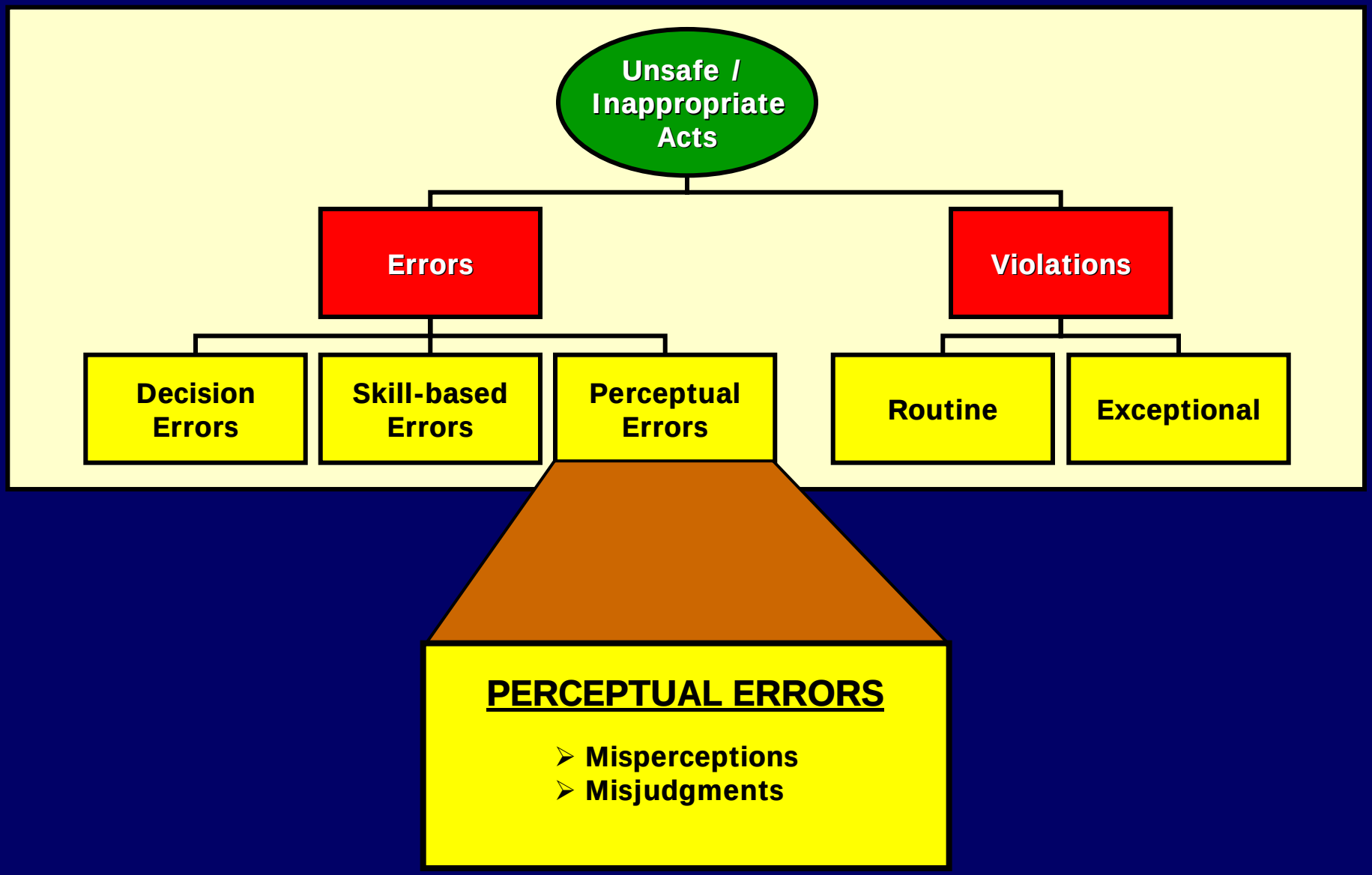

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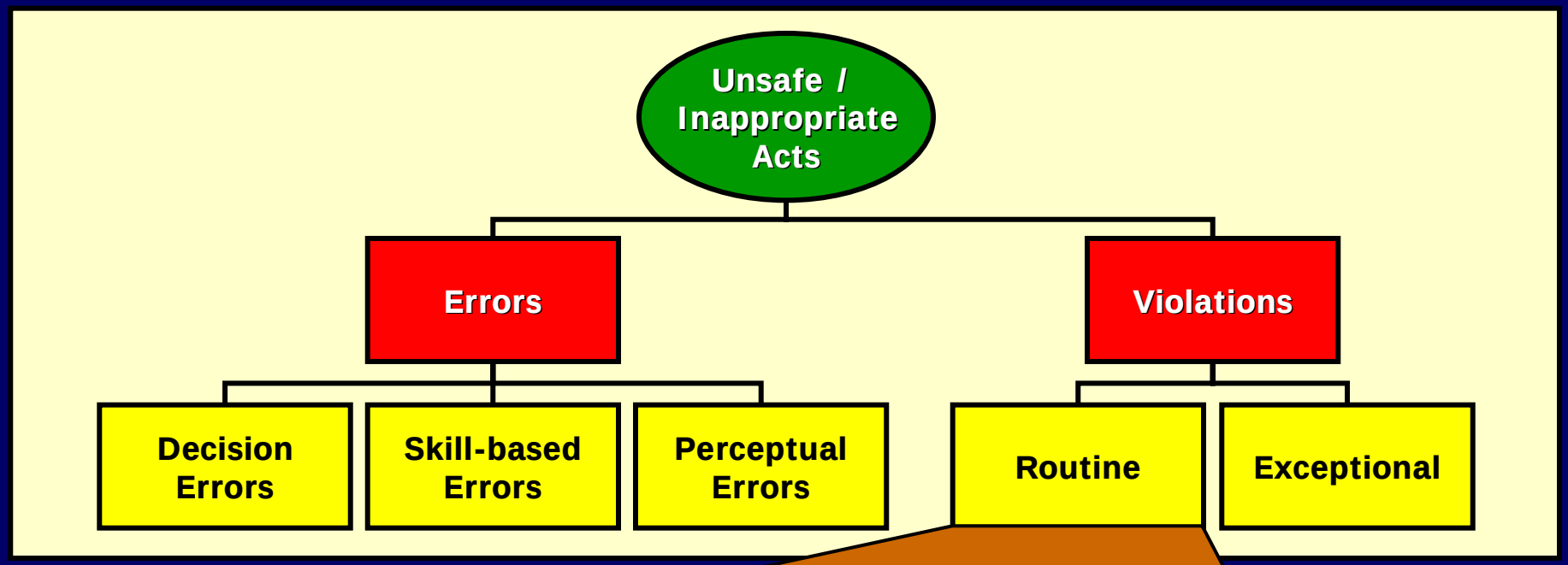

ROUTINE VIOLATIONS

(Habitual departures from rules condoned by management)

- **Violated training rules**
- **Failed to comply with departmental manuals**
- **Violation of orders, regulations, and/or SOPs**

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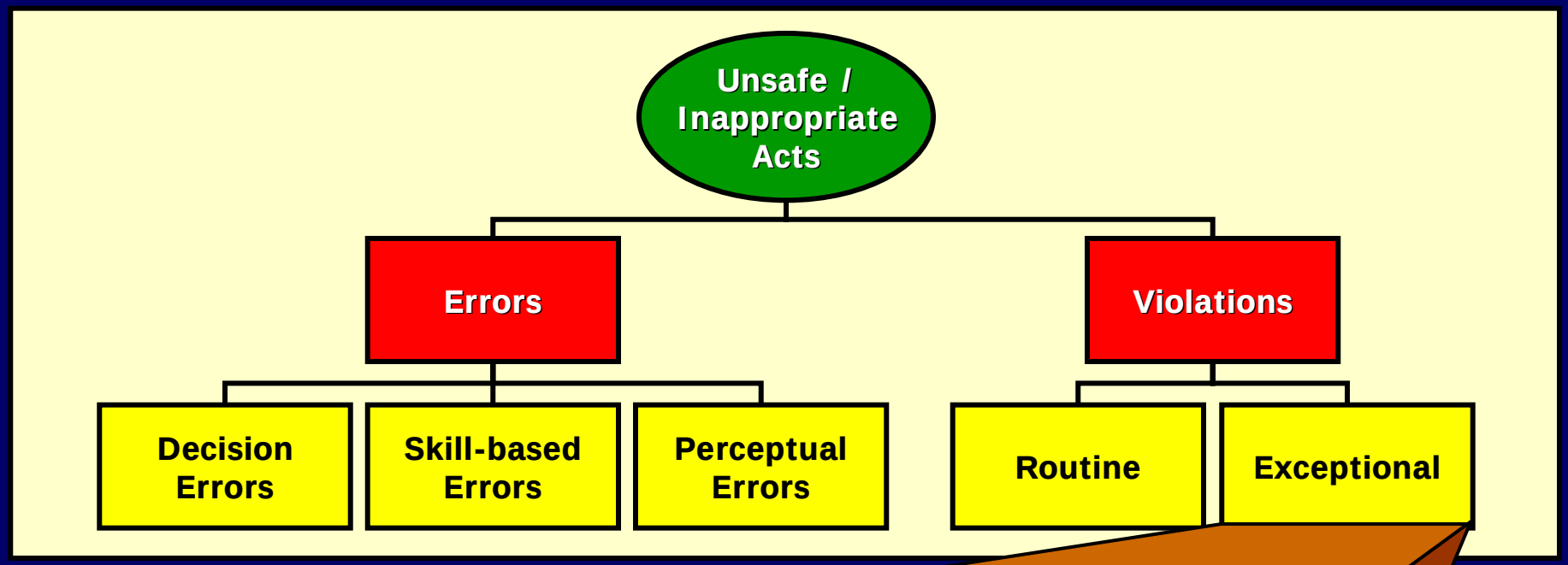

EXCEPTIONAL VIOLATIONS

(Isolated departures from the rules not condoned by management)

- **Performed unauthorized operation**
- **Accepted unauthorized hazard**
- **Not current / qualified**

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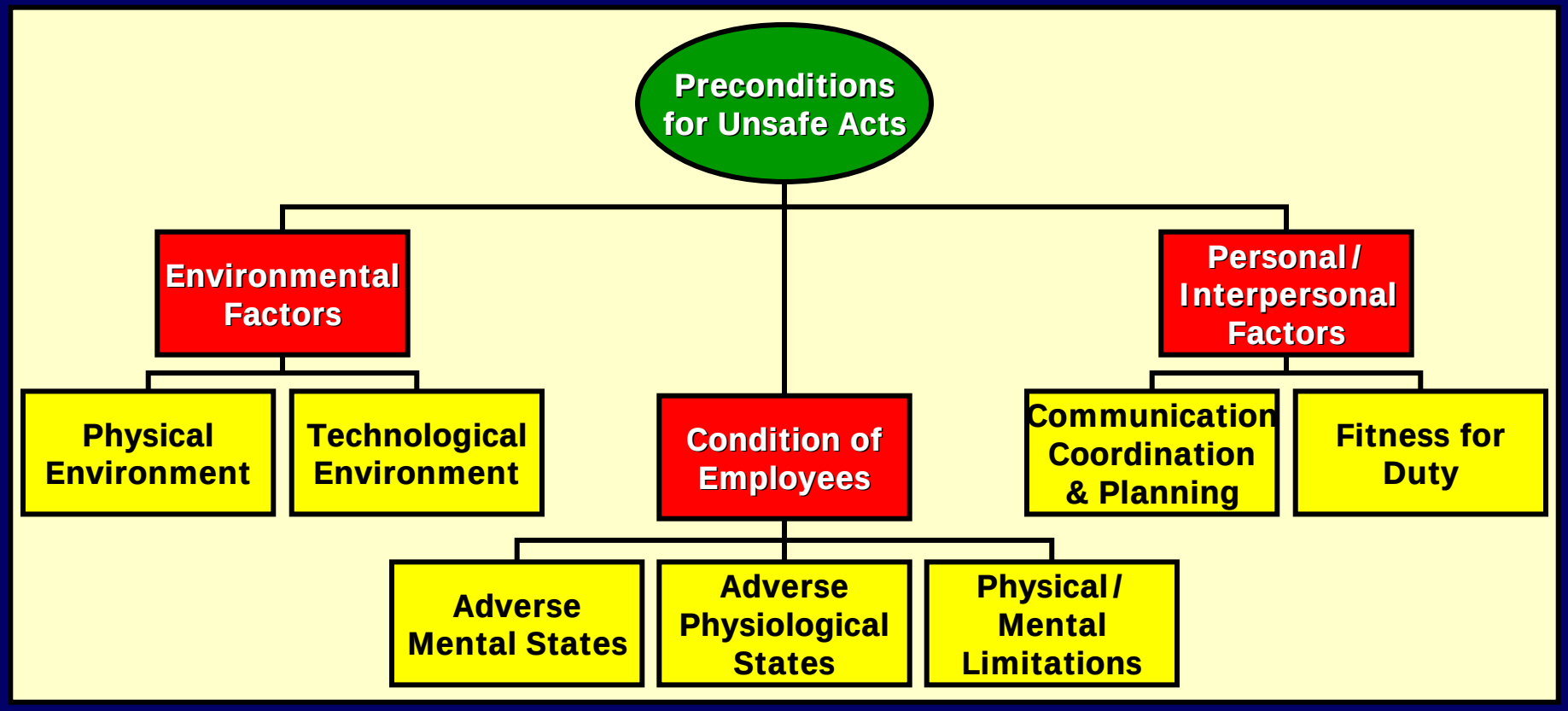

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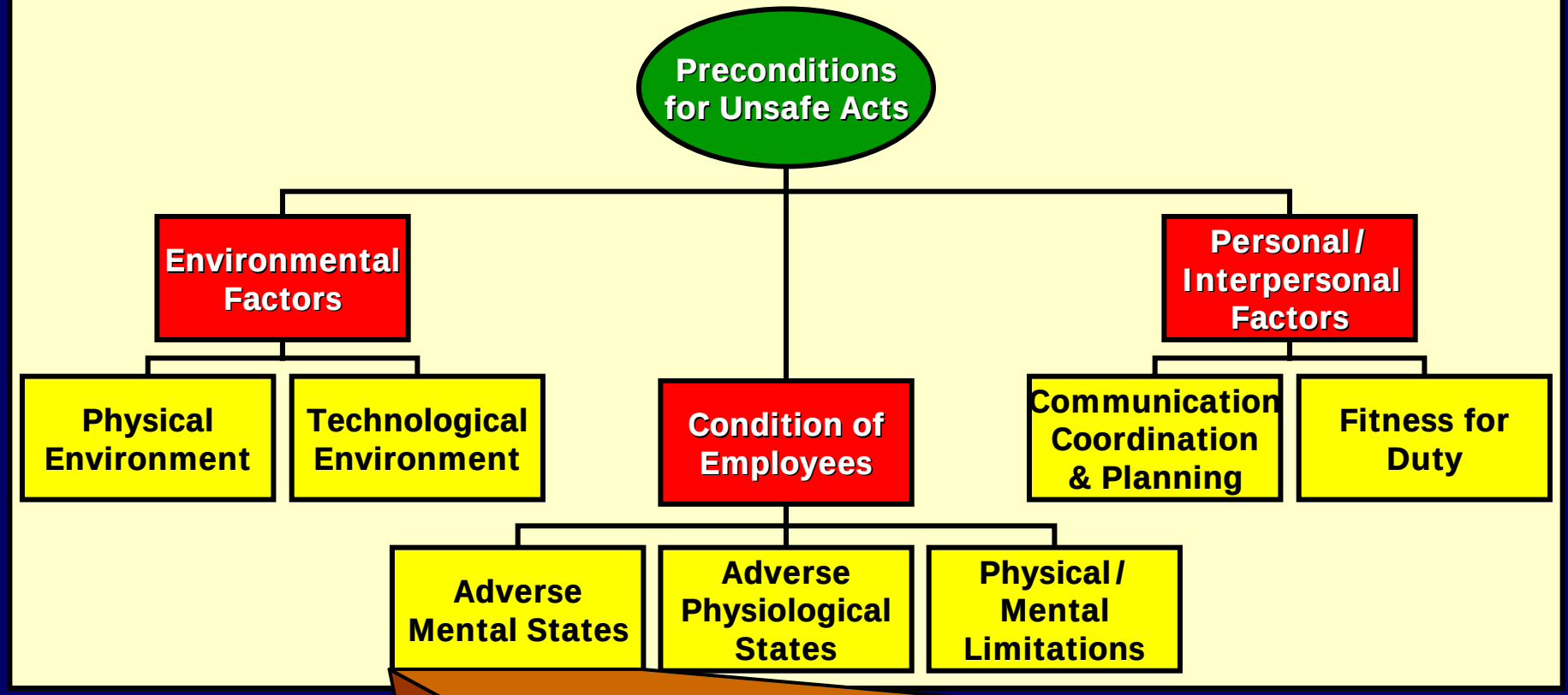

ADVERSE MENTAL STATES

- Complacency
- Stress
- Overconfidence
- Mental fatigue
- Distraction
- Confusion

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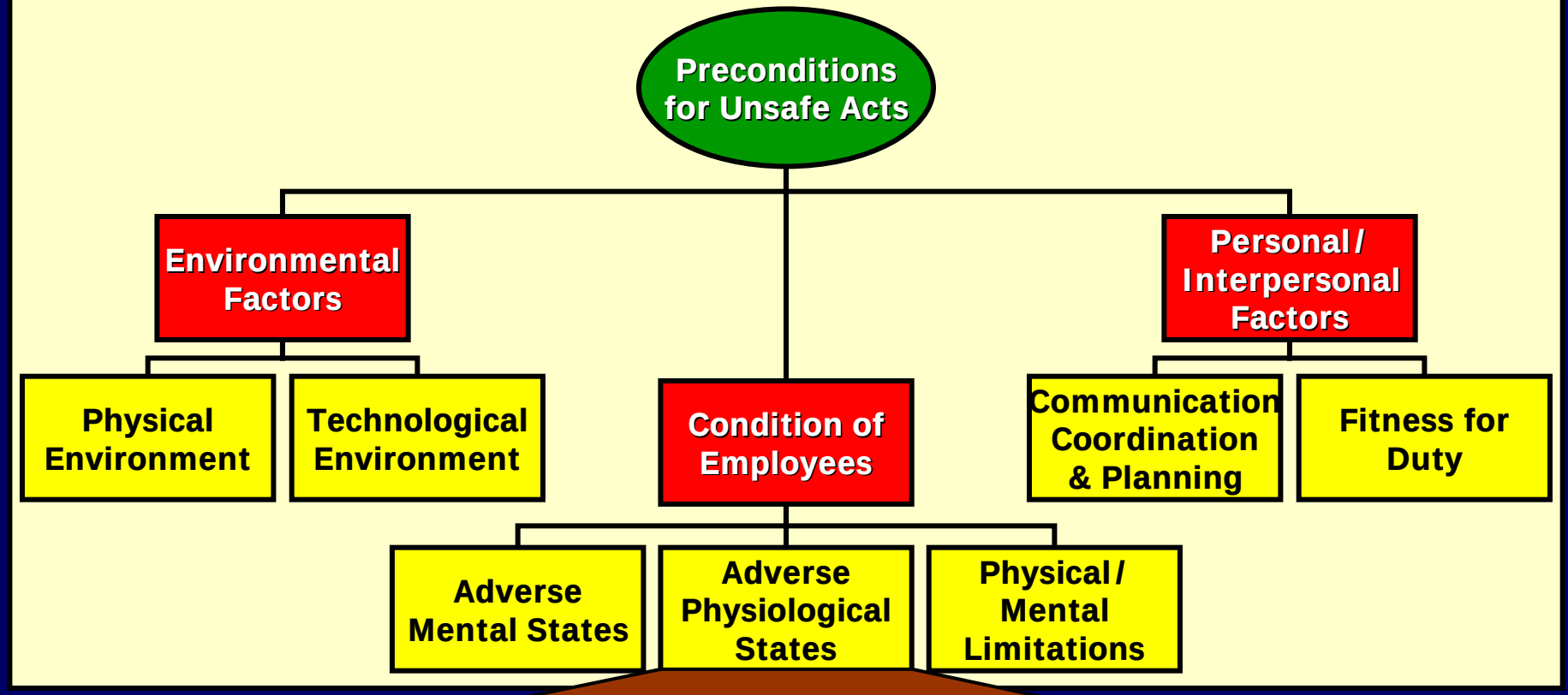

ADVERSE PHYSIOLOGICAL STATES

- Physical fatigue
- Spatial disorientation
- Visual Illusions
- Hypoxia
- Medical illness

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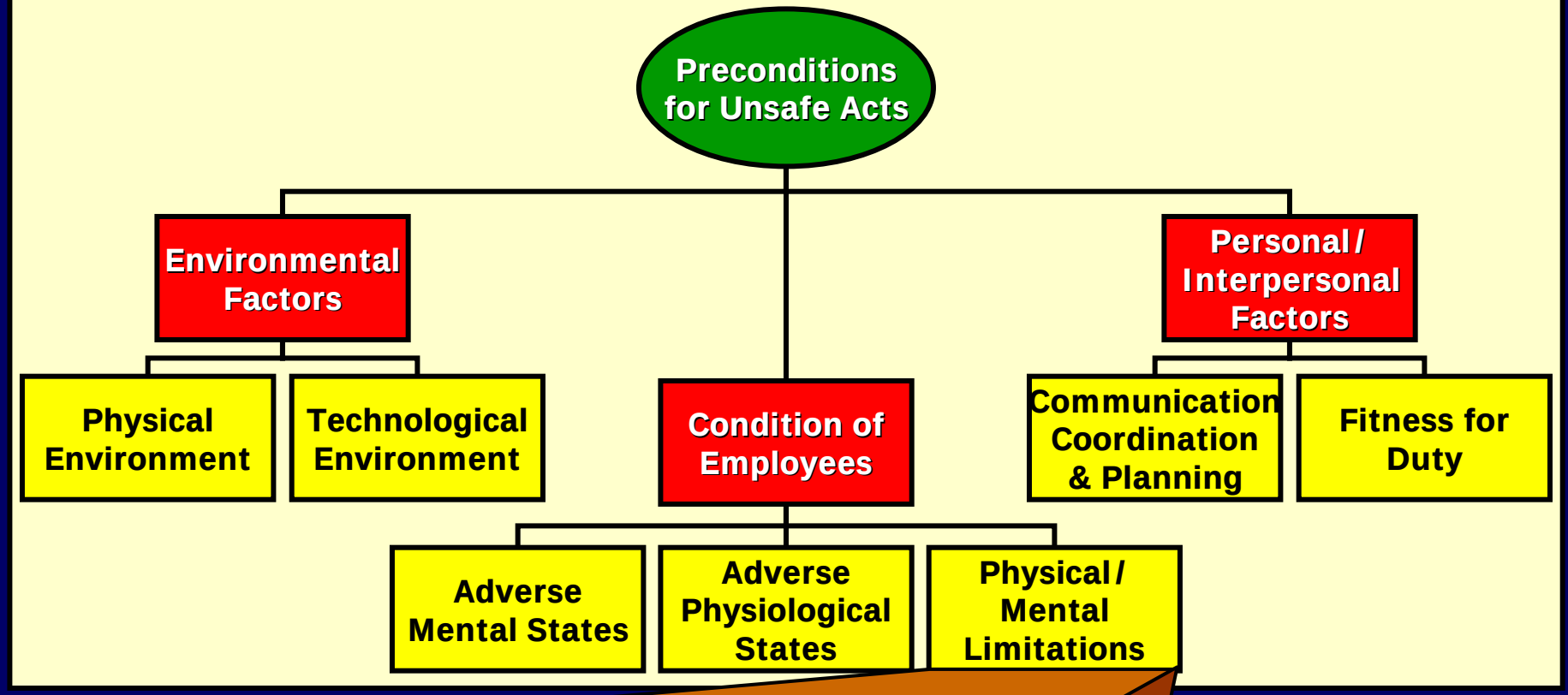

PHYSICAL / MENTAL LIMITATIONS

- Visual limitations
- Hearing limitation
- Not current / qualified
- Incompatible physical capability
- Incompatible intelligence / aptitude

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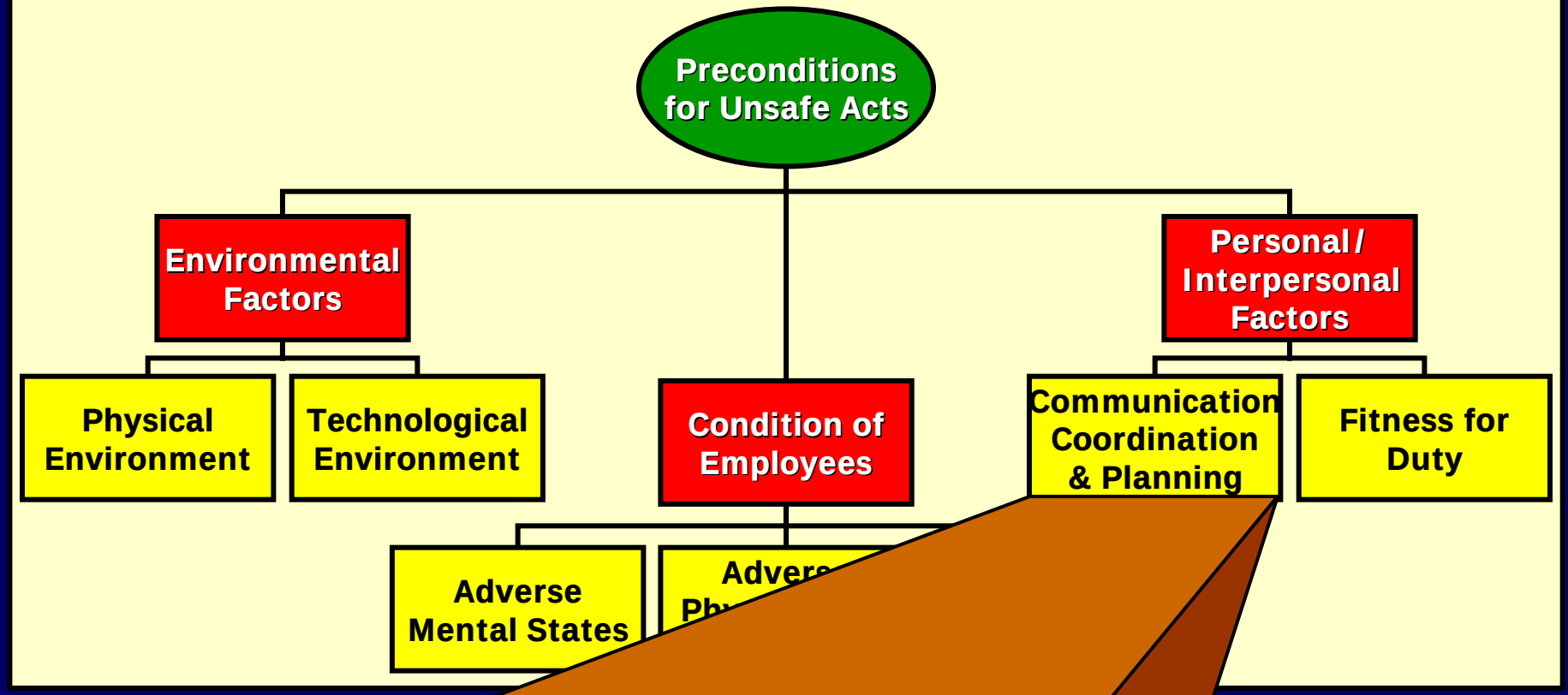

Communication Coordination & Planning

- Failed to conduct adequate brief
- Lack of teamwork
- Poor communication / coordination
- Failure of leadership

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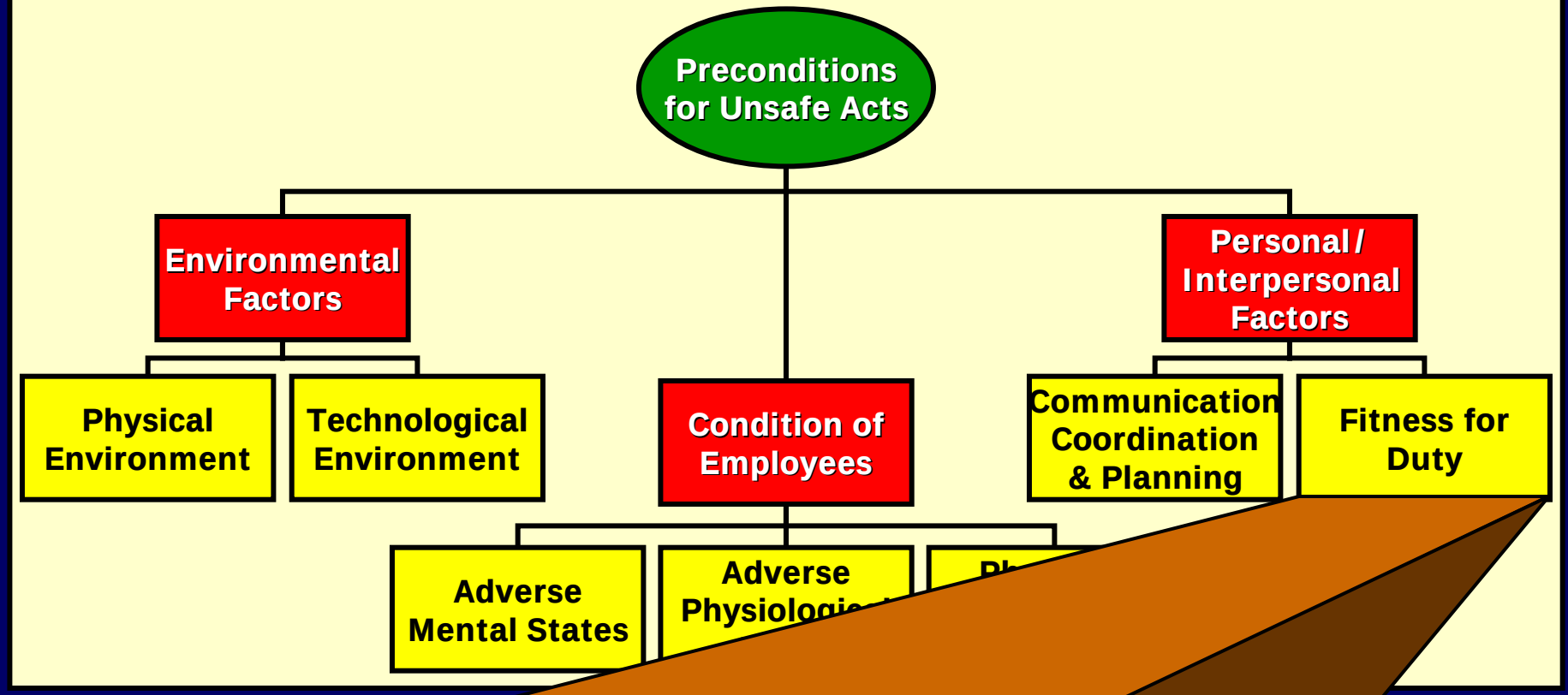

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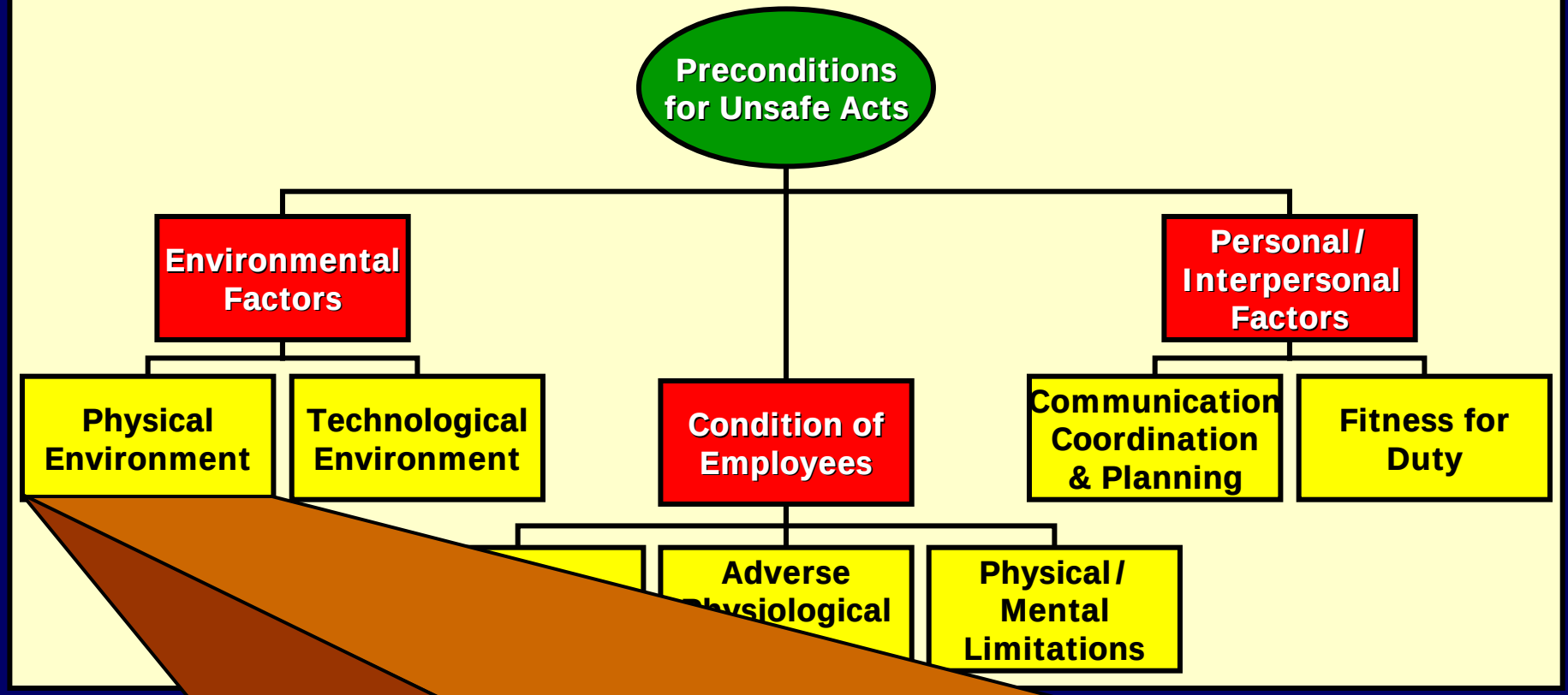

PHYSICAL ENVIRONMENT

- Weather
- Lighting
- Noise
- Heat
- Vibration

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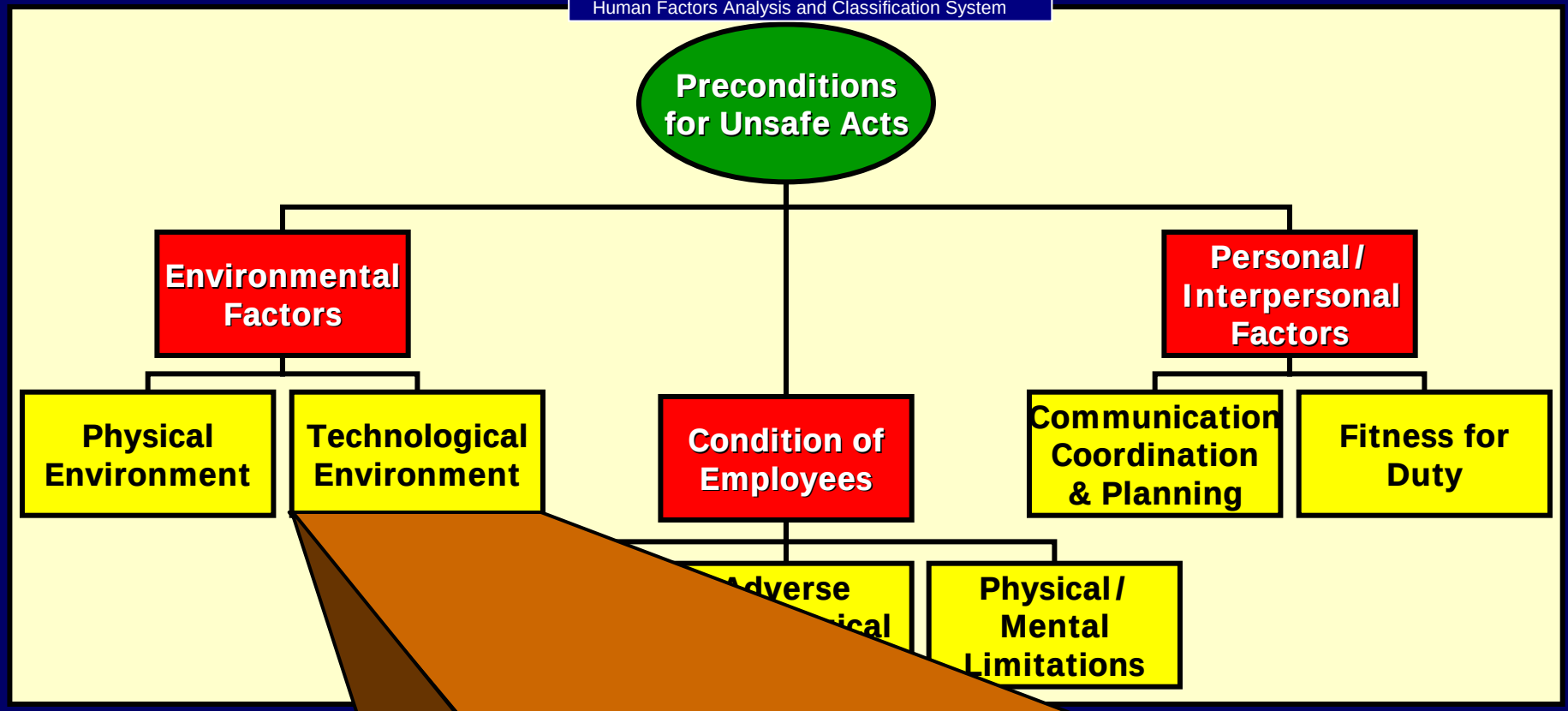

TECHNOLOGICAL ENVIRONMENT

- Equipment and controls
- Automation reliability/complexity
- Task and Procedure Design
- Manuals and Checklist Design
- Interfaces and Displays

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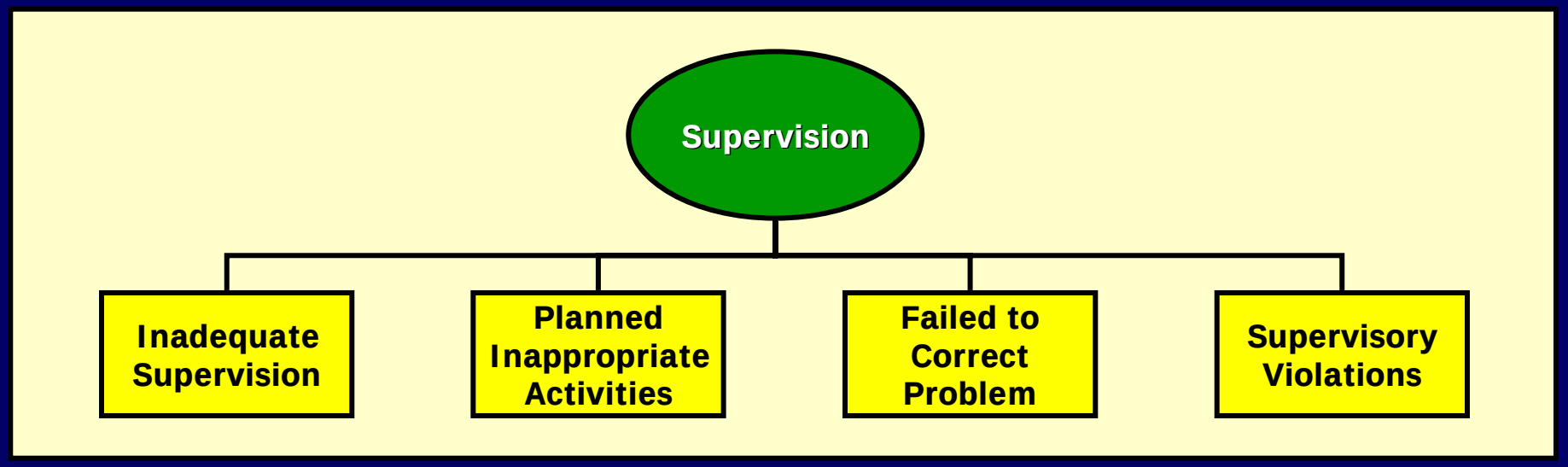

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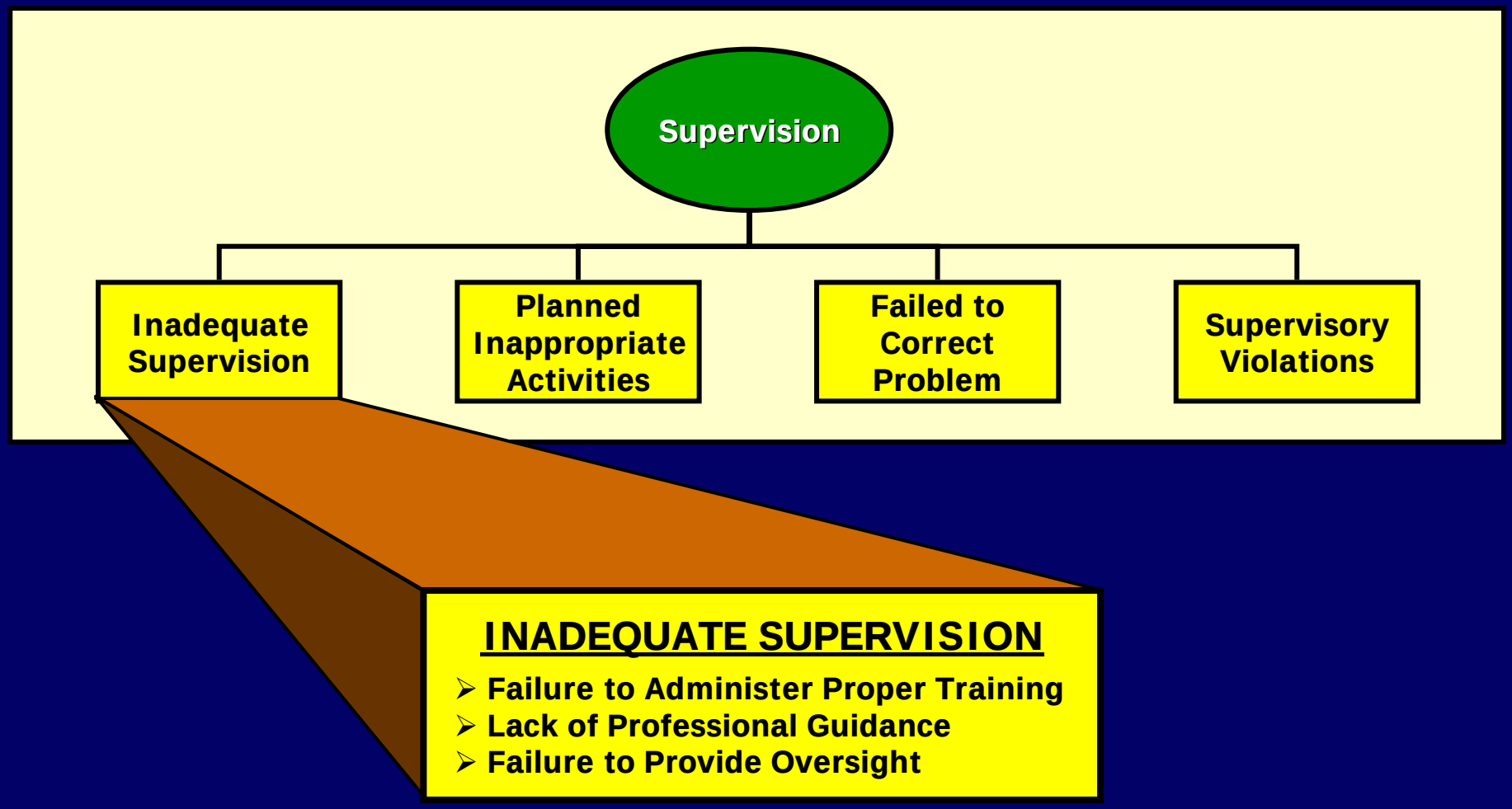

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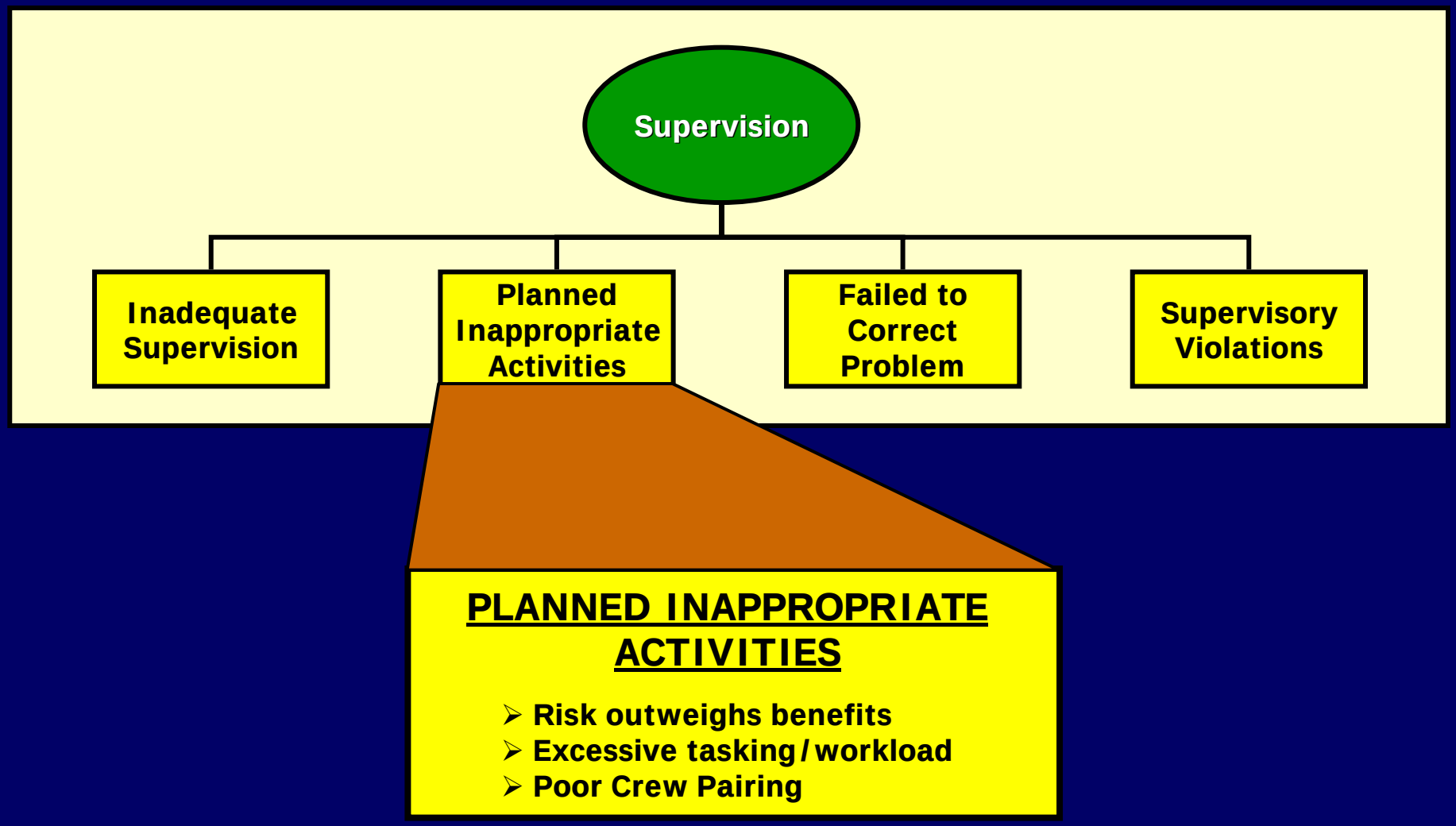

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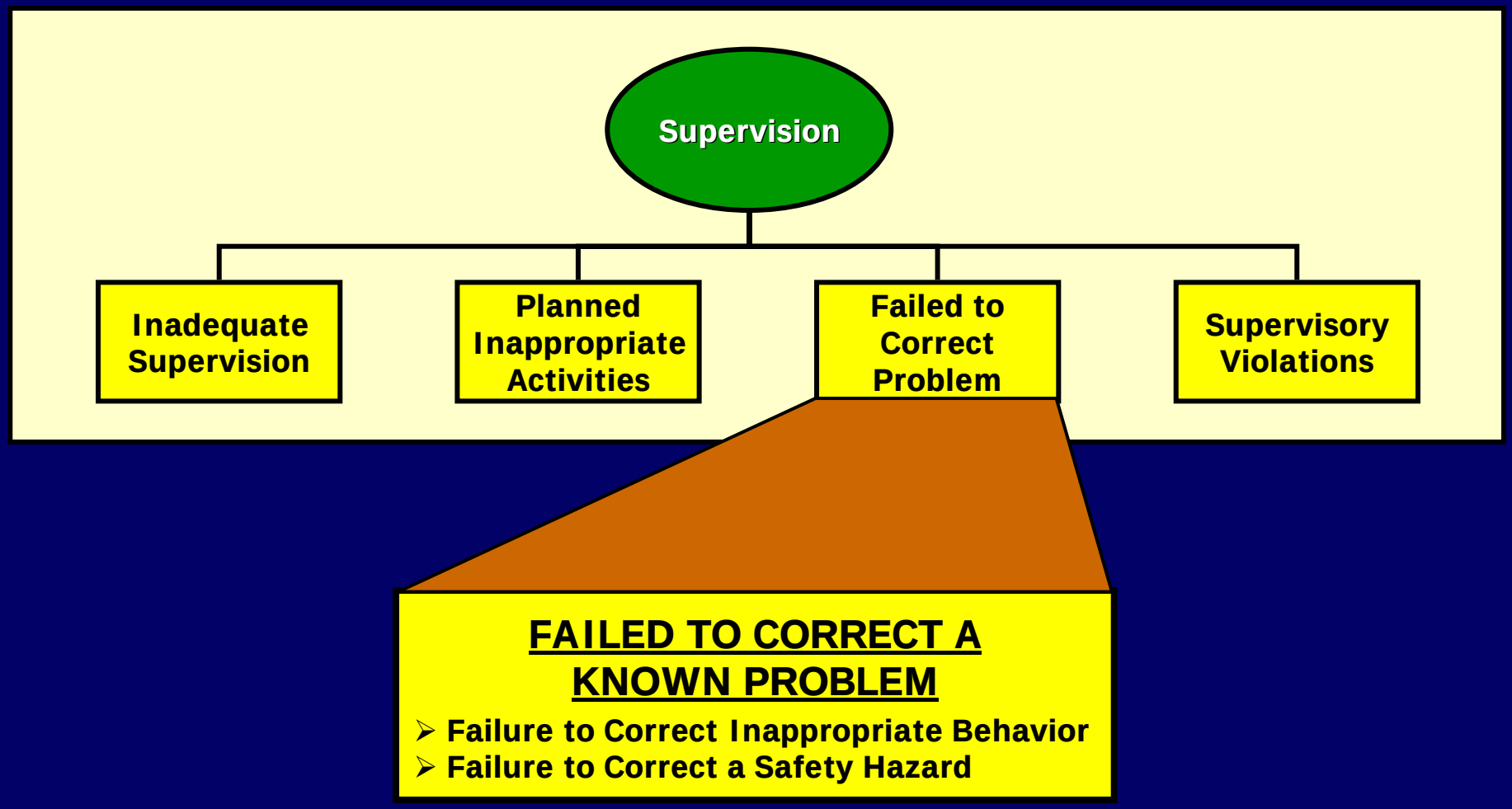

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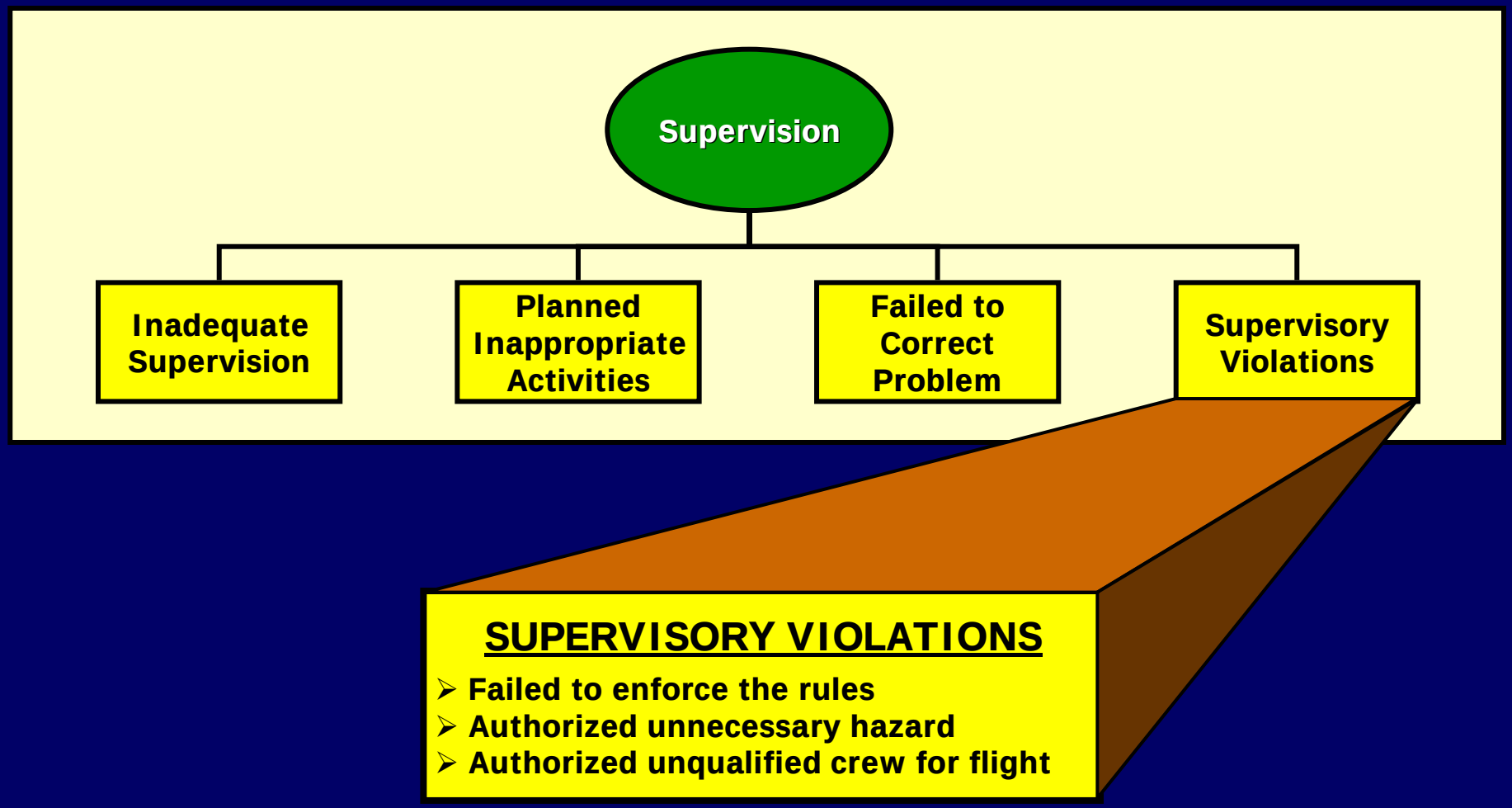

SUPERVISORY VIOLATIONS

- Failed to enforce the rules
- Authorized unnecessary hazard
- Authorized unqualified crew for flight

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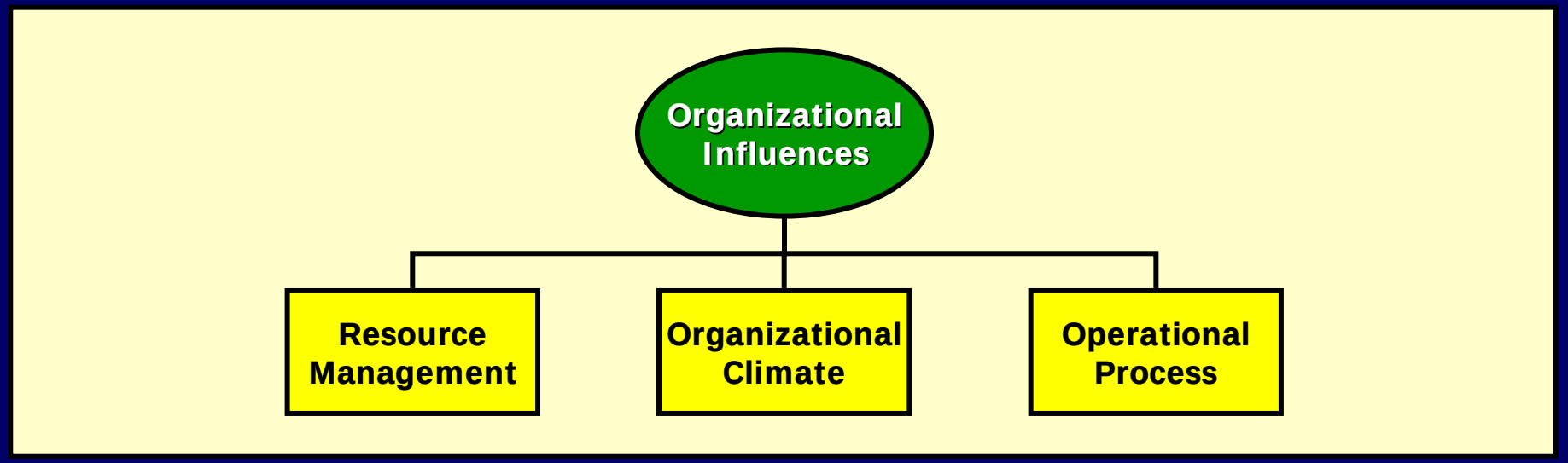

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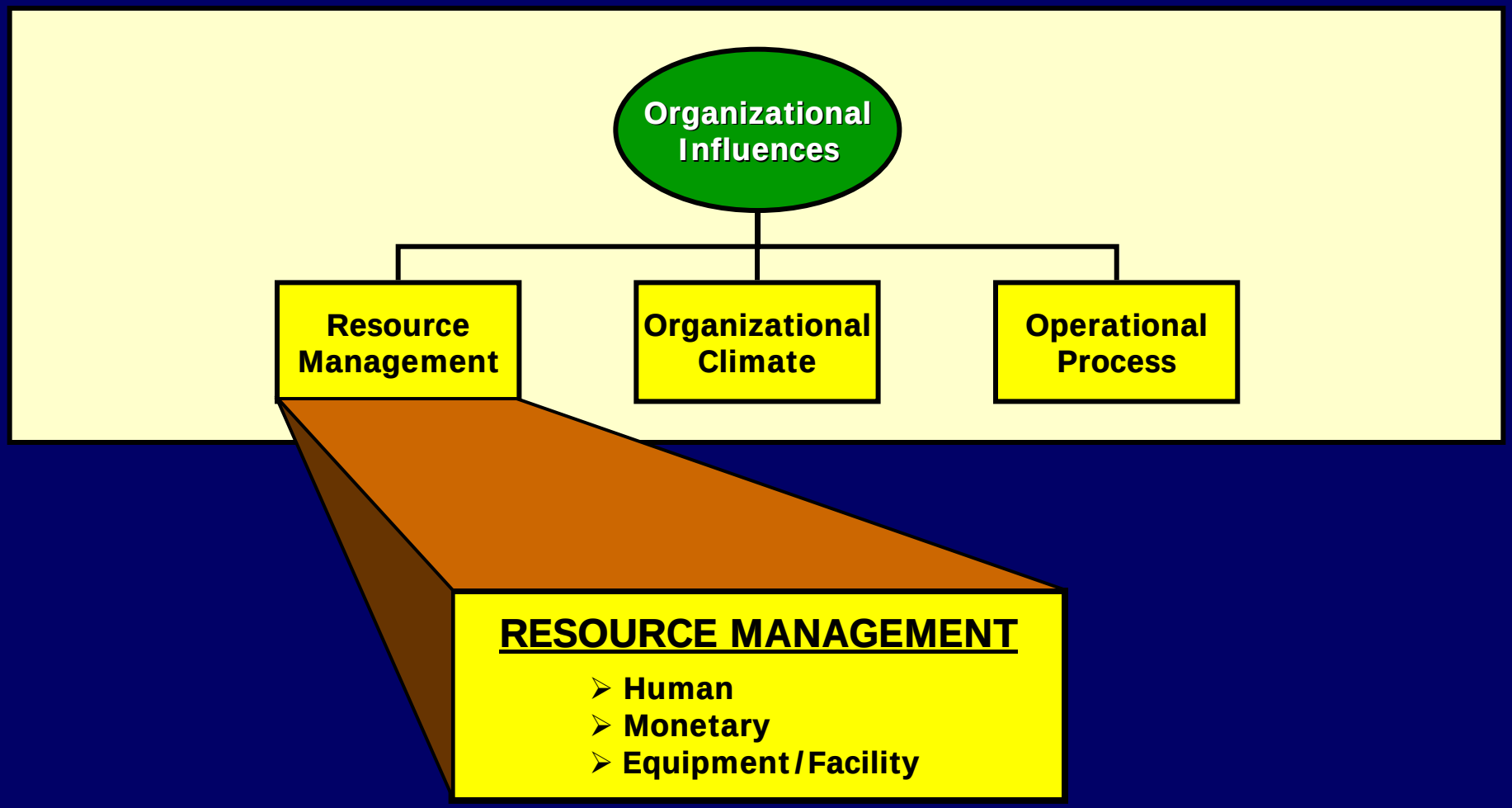

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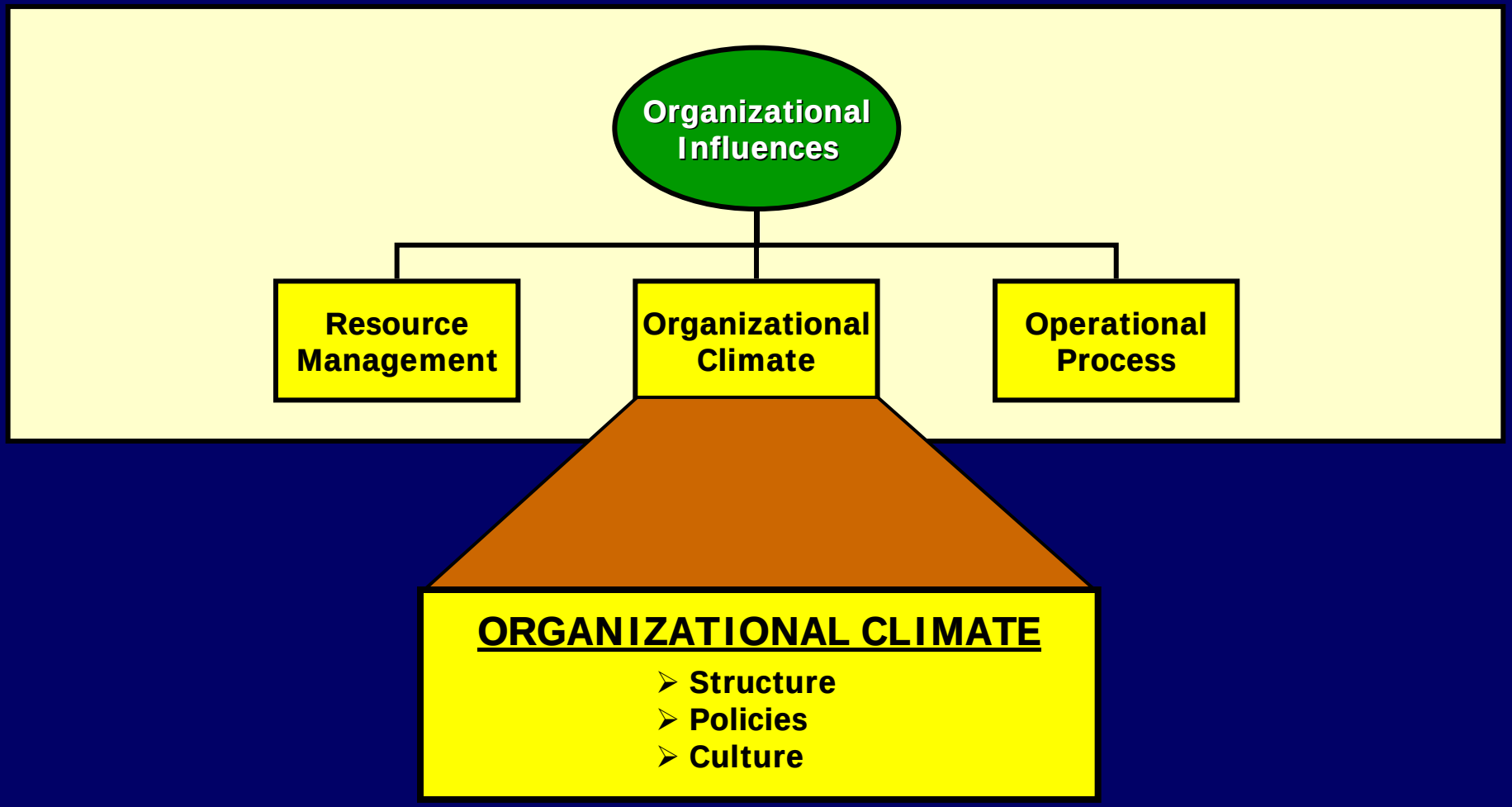

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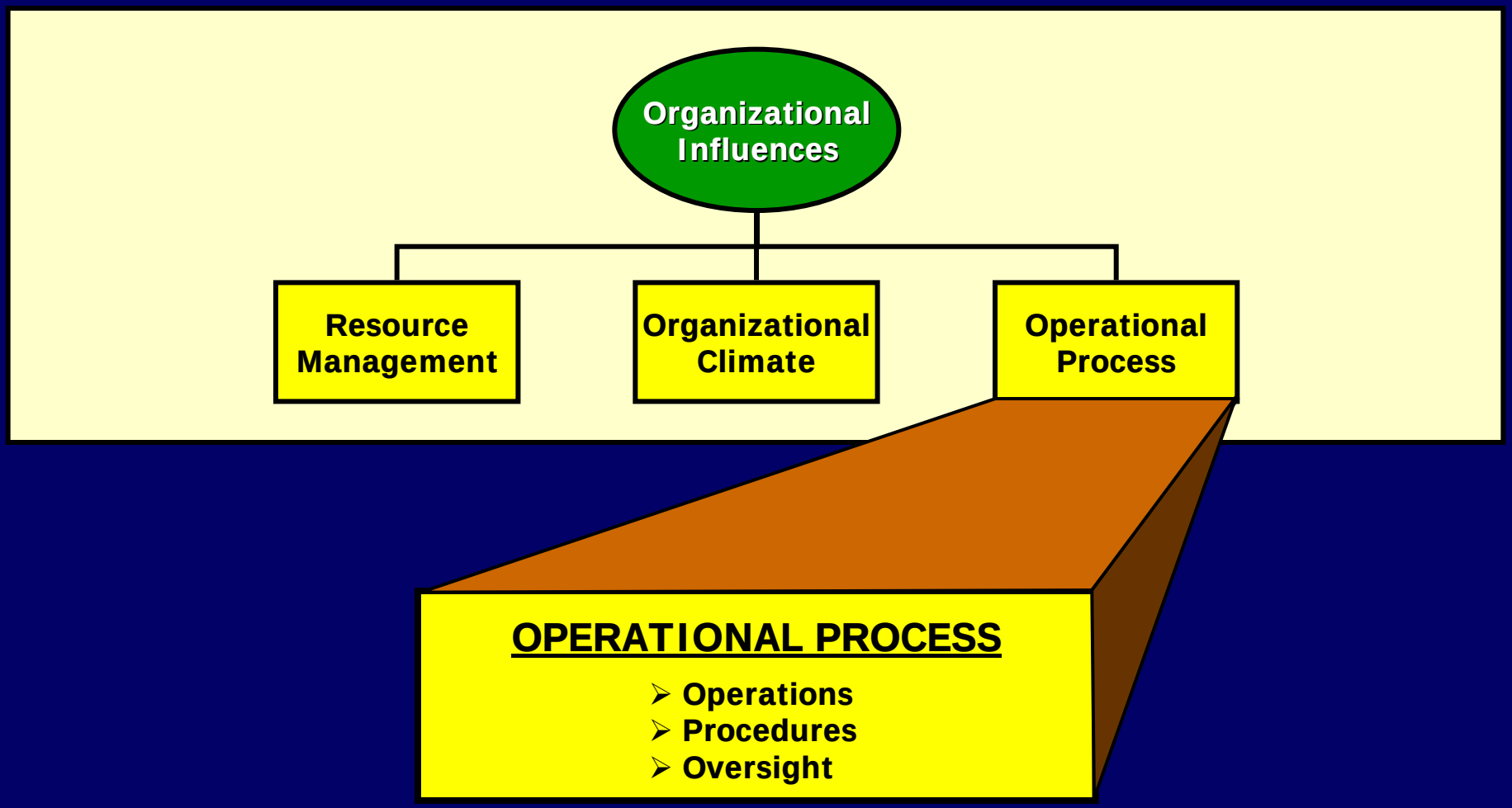

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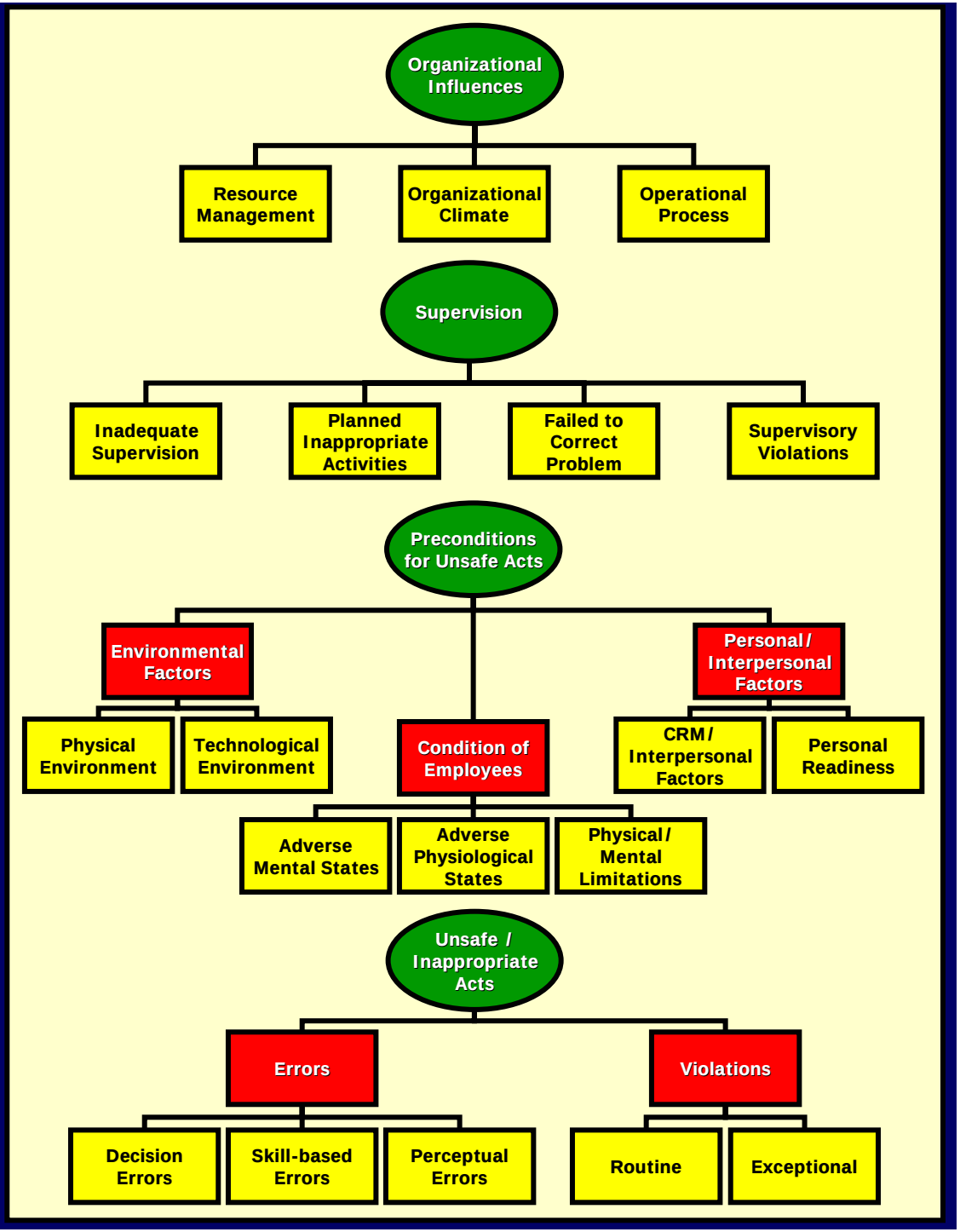

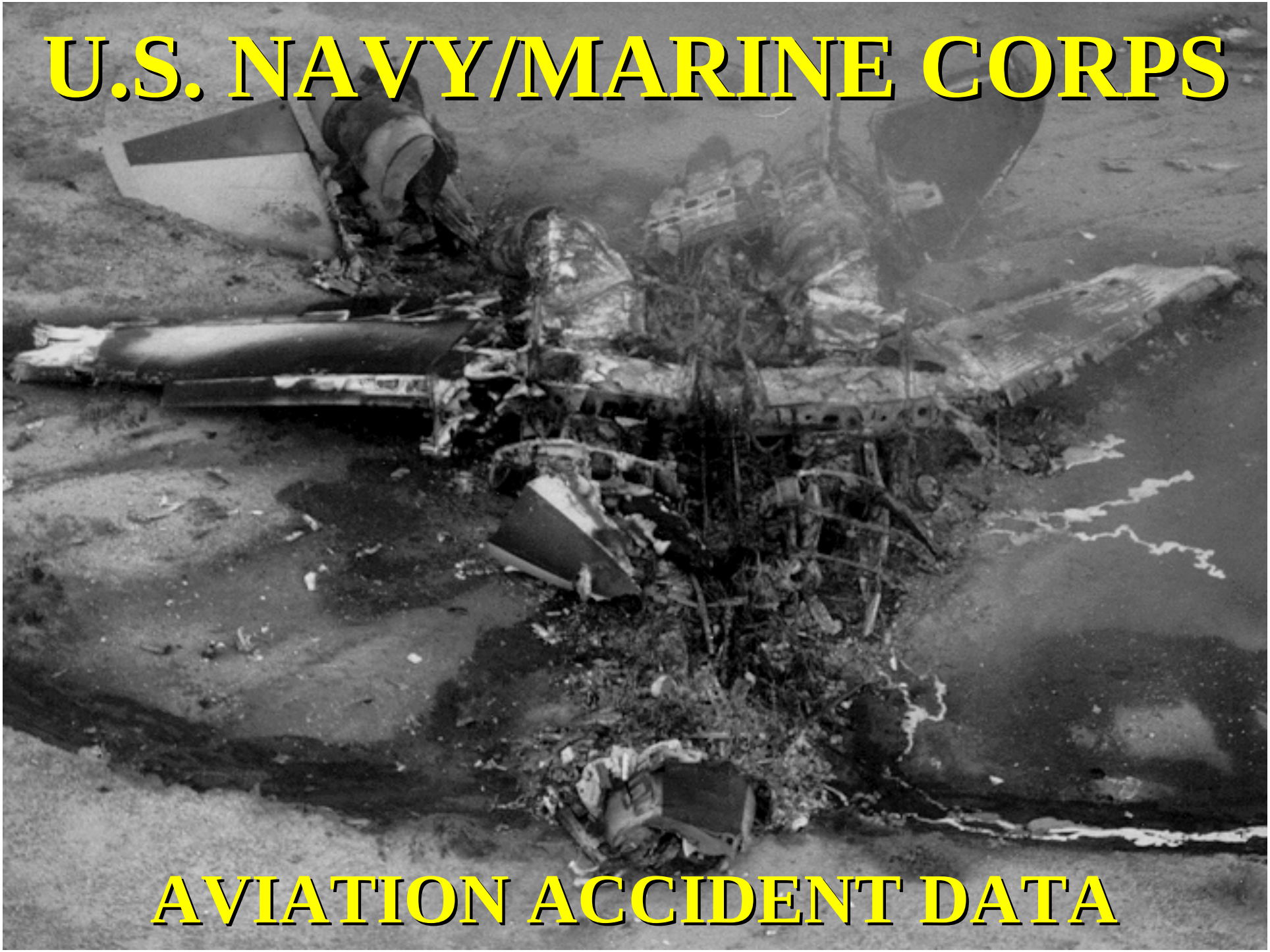
U.S. NAVY/MARINE CORPS
AVIATION ACCIDENT DATA

USN/USMC
Methodology

- Analyzed all Class A Mishaps between FY91-99 associated with human error (n=178)
- Analyses included all human causal factors as identified in the original investigation and endorsed by the Chain of Command
- NO new causal factors were identified
- Raters
  - 2 Aerospace Psychologists
  - 2 Flight Surgeons
  - Airframe Rated Pilot/NFO Subject Matter Experts
- Consensus rating

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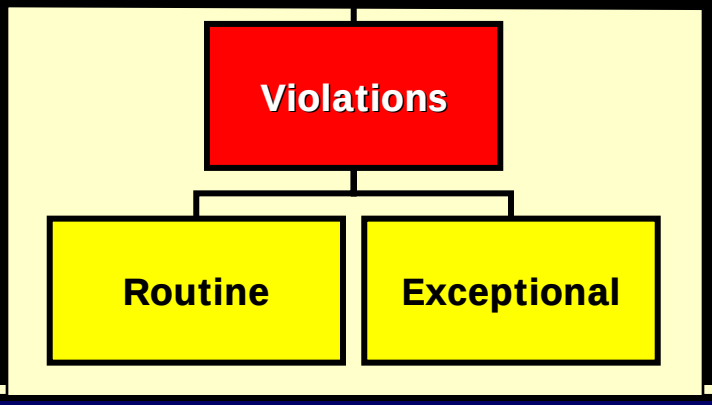
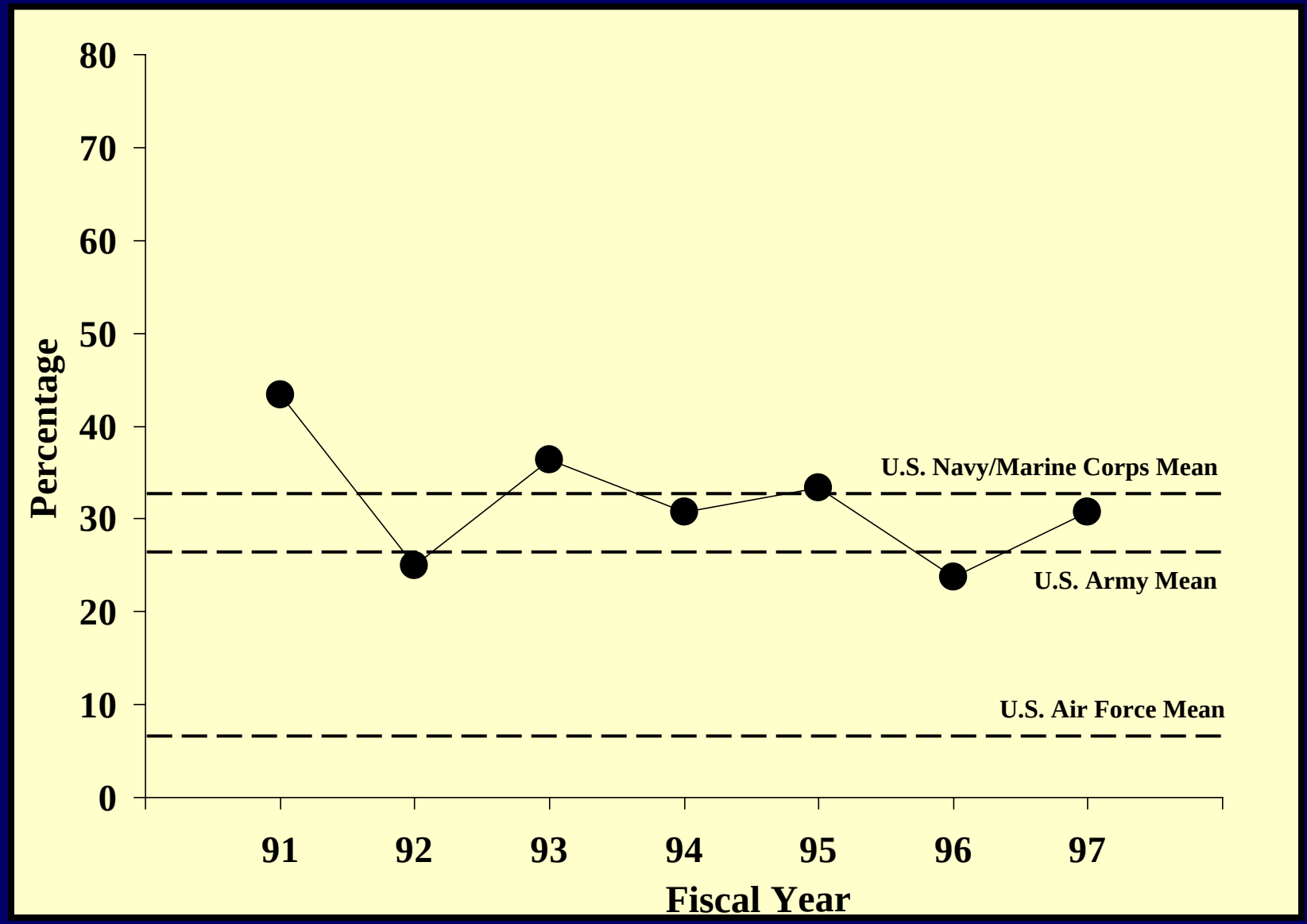
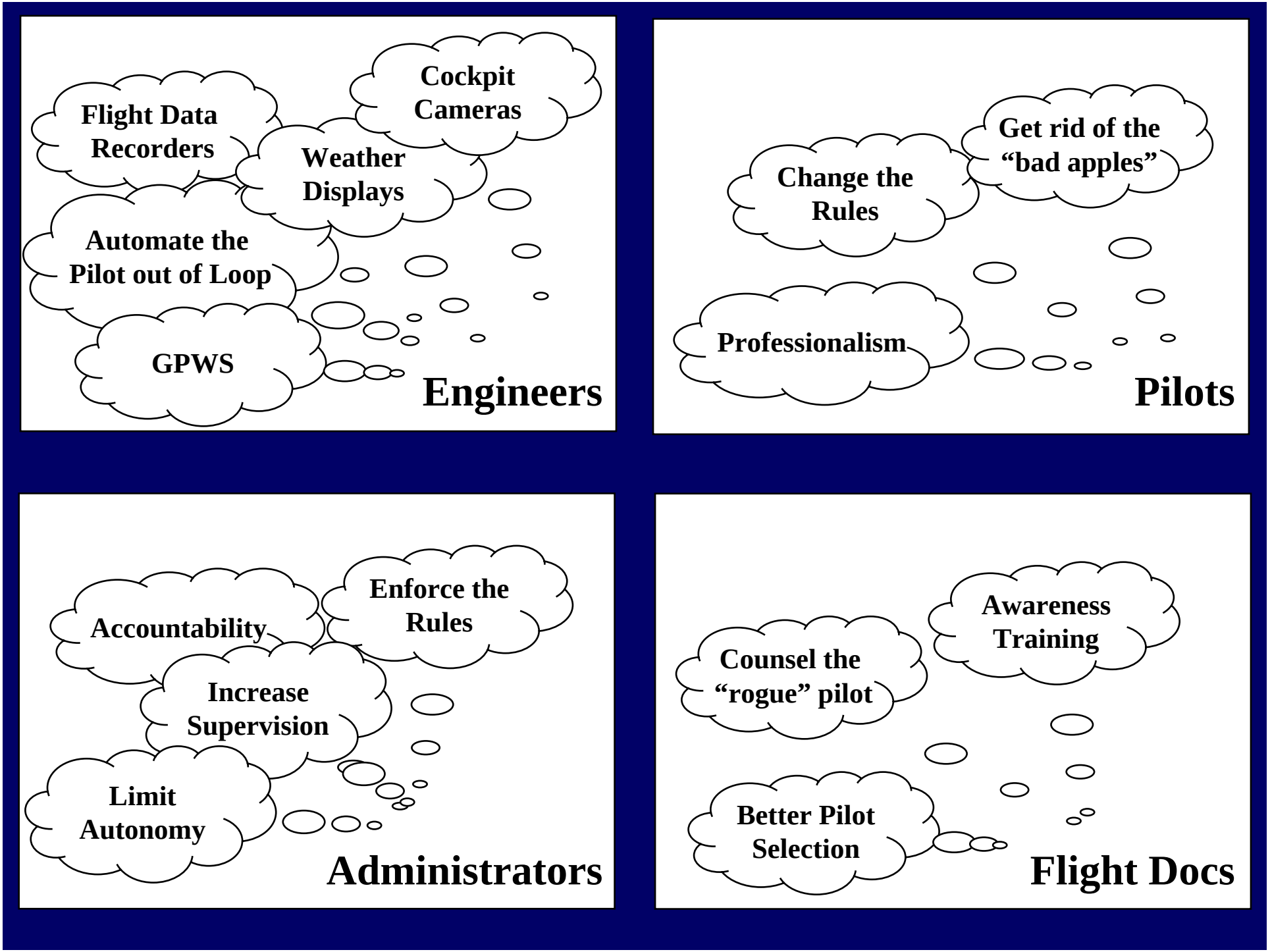
Human Factors Analysis and Classification System

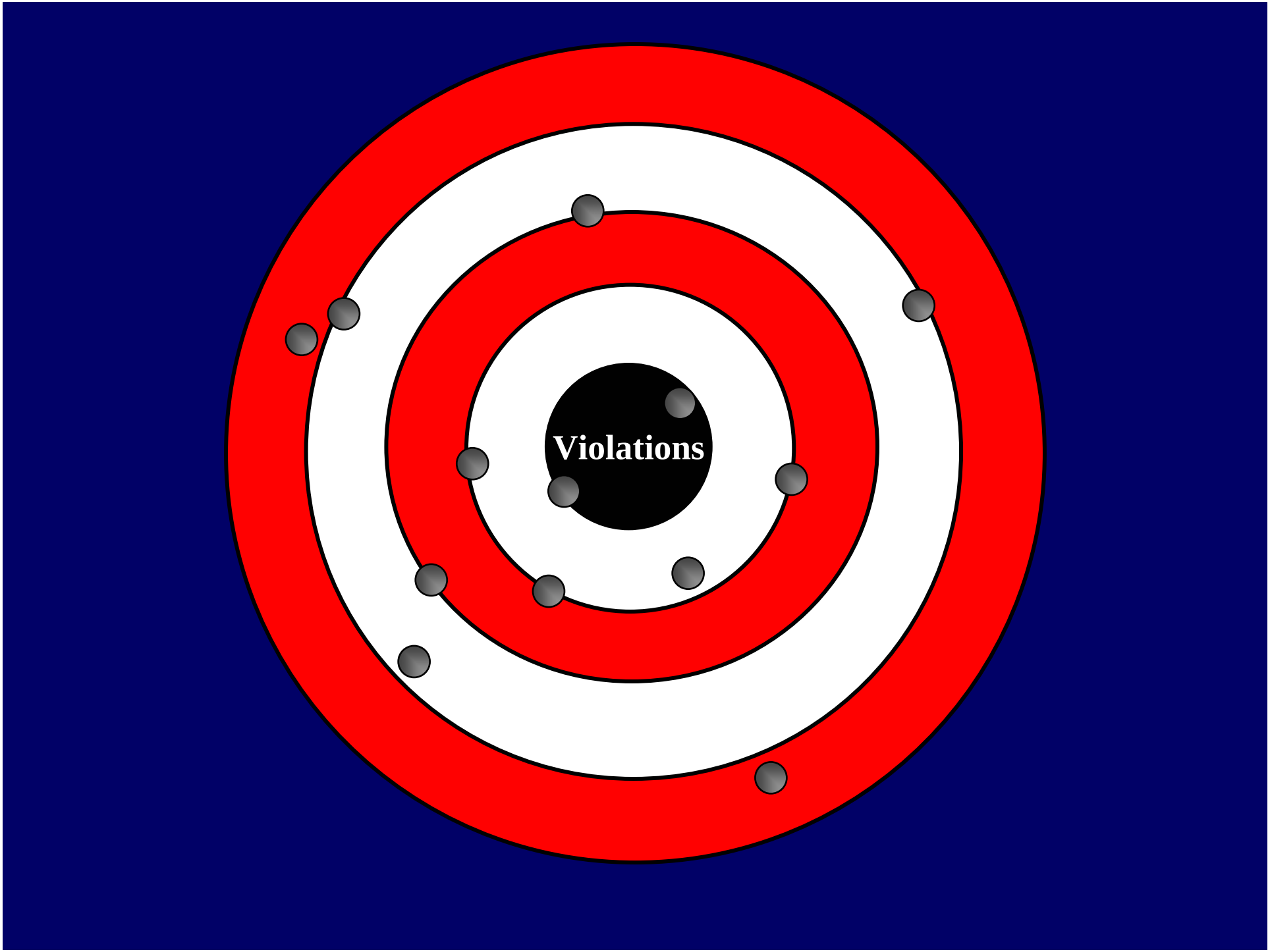


Percentage of Human Error Mishaps Associated with Violations (FY 91-97)



OK Doc, Go Fix It!


Flight Data Recorders
Cockpit Cameras
Weather Displays
Automate the Pilot out of Loop
GPWS
Engineers
Change the Rules
Get rid of the "bad apples"
Professionalism
Pilots
Accountability
Enforce the Rules
Increase Supervision
Limit Autonomy
Administrators
Counsel the "rogue" pilot
Awareness Training
Better Pilot Selection
Flight Docs


Violations

- **Environment (Hazard) -Centered**
- **Technology-Centered**
- **Task-Centered**
- **Human-Centered**
- **Administrative/Org-Centered**

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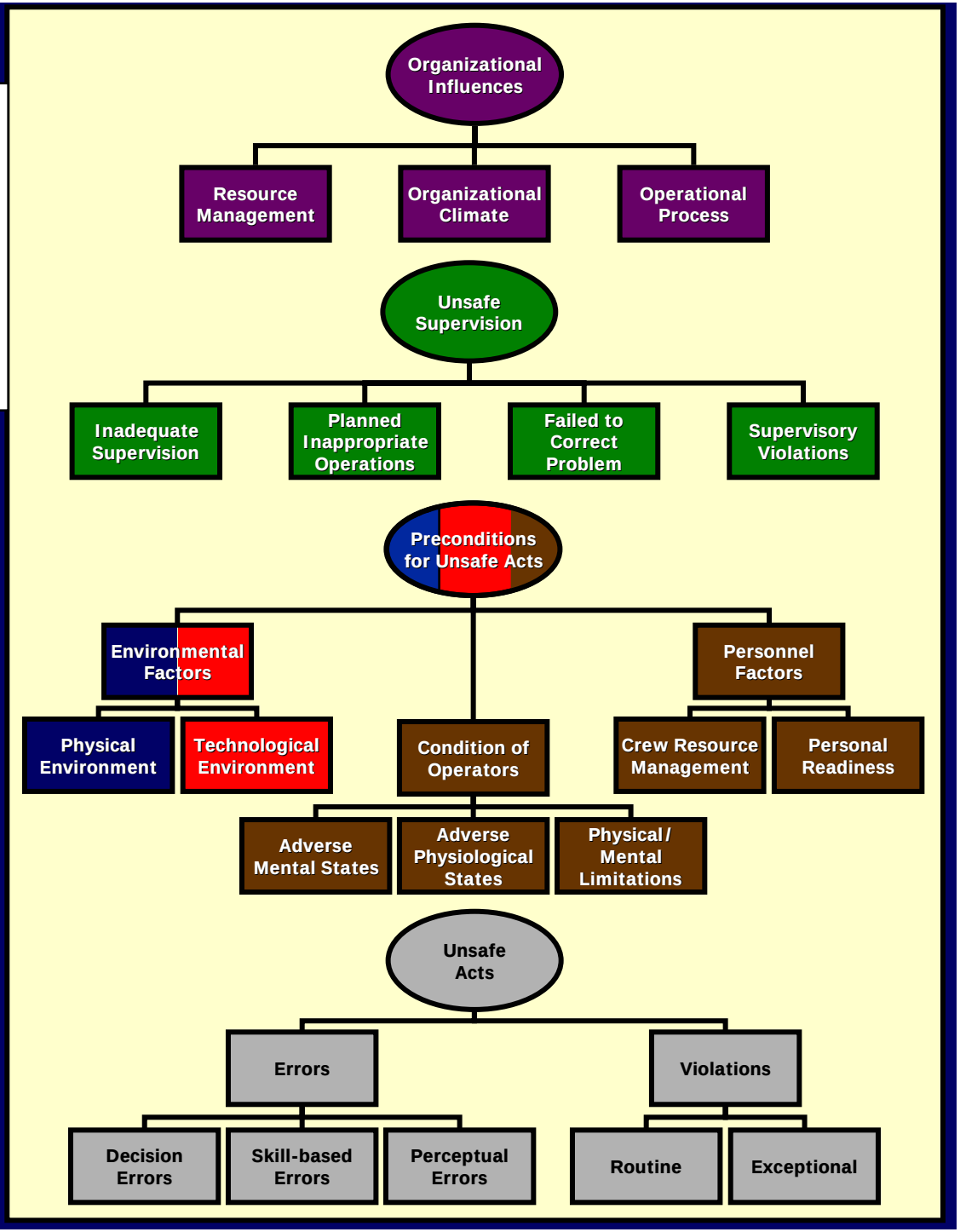


HFIX®

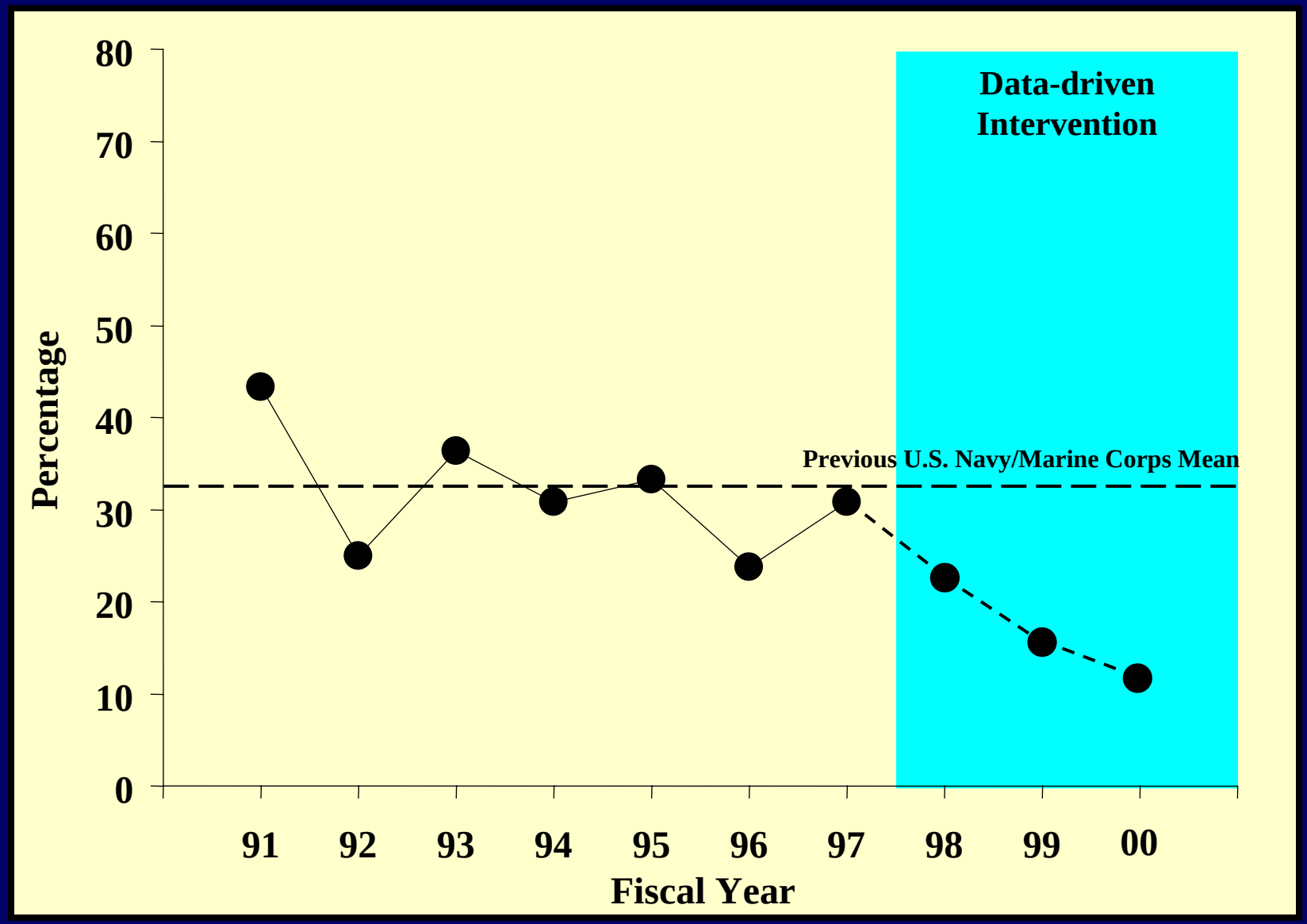
Human Factors Intervention matriX

	Organizational/ Administrative	Human/ Crew	Technology/ Engineering	Task/ Mission	Operational/ Physical Environment
Decision Errors			**Weather Displays**		
Skill-based Errors			**GPWS**		
Perceptual Errors			**Synthetic Vision**		
Violations	**Accountability** **Enforcement** **Increase Supervision** **Limit Autonomy**	**Pilot Selection** **Counseling** **Awareness Training**	**Cockpit Cameras** **Flight Data Recorders**	**Need for Low-level Flight (EA-6B)** **Detachment Mentality (SH-60)** **Procedures for Fuel Dumping/Burn**	**Training in Restricted Areas Only**

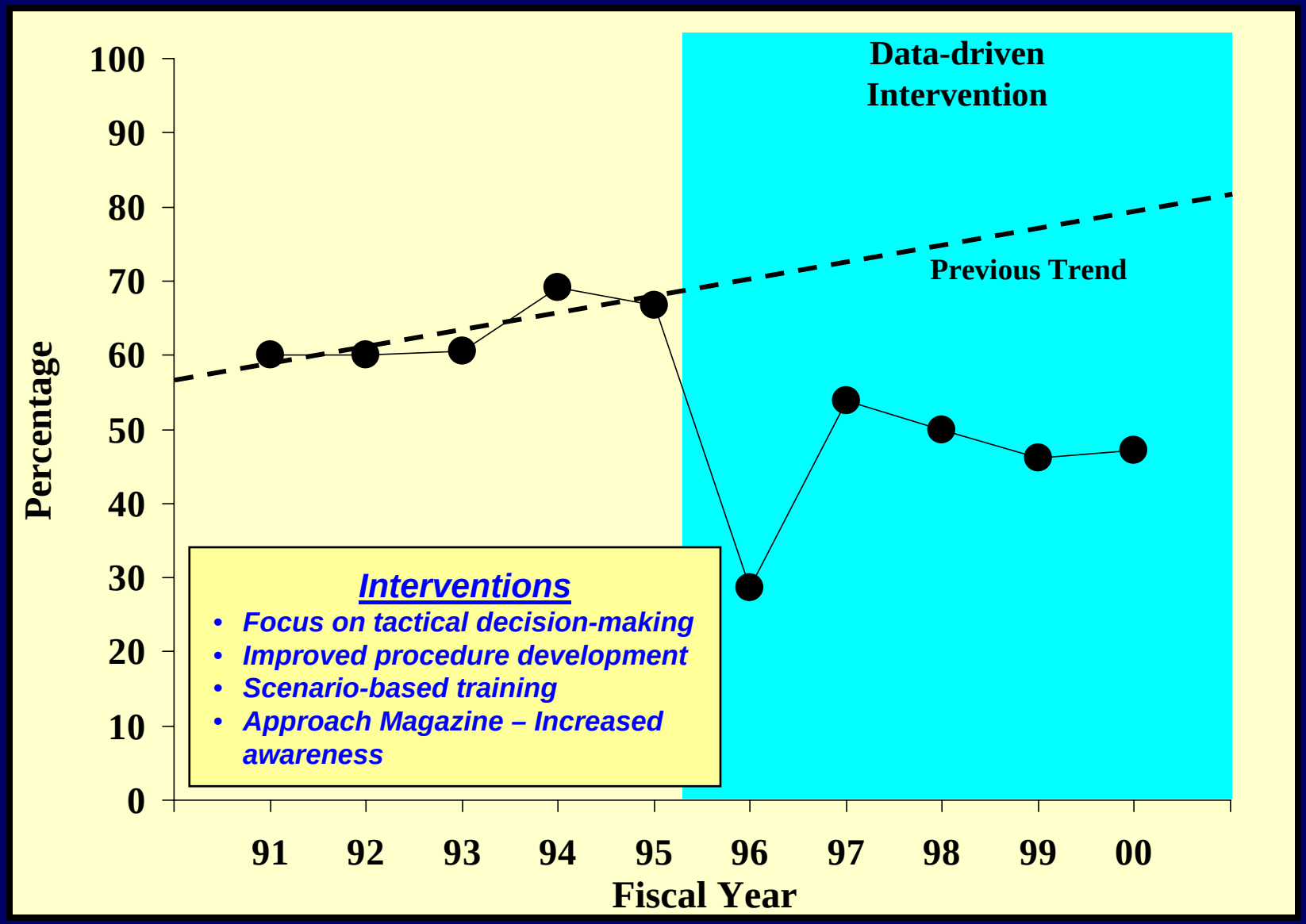
Initial Intervention Strategy

- Professionalism
- Accountability
- Enforcing the Rules
- Detachment Supervision

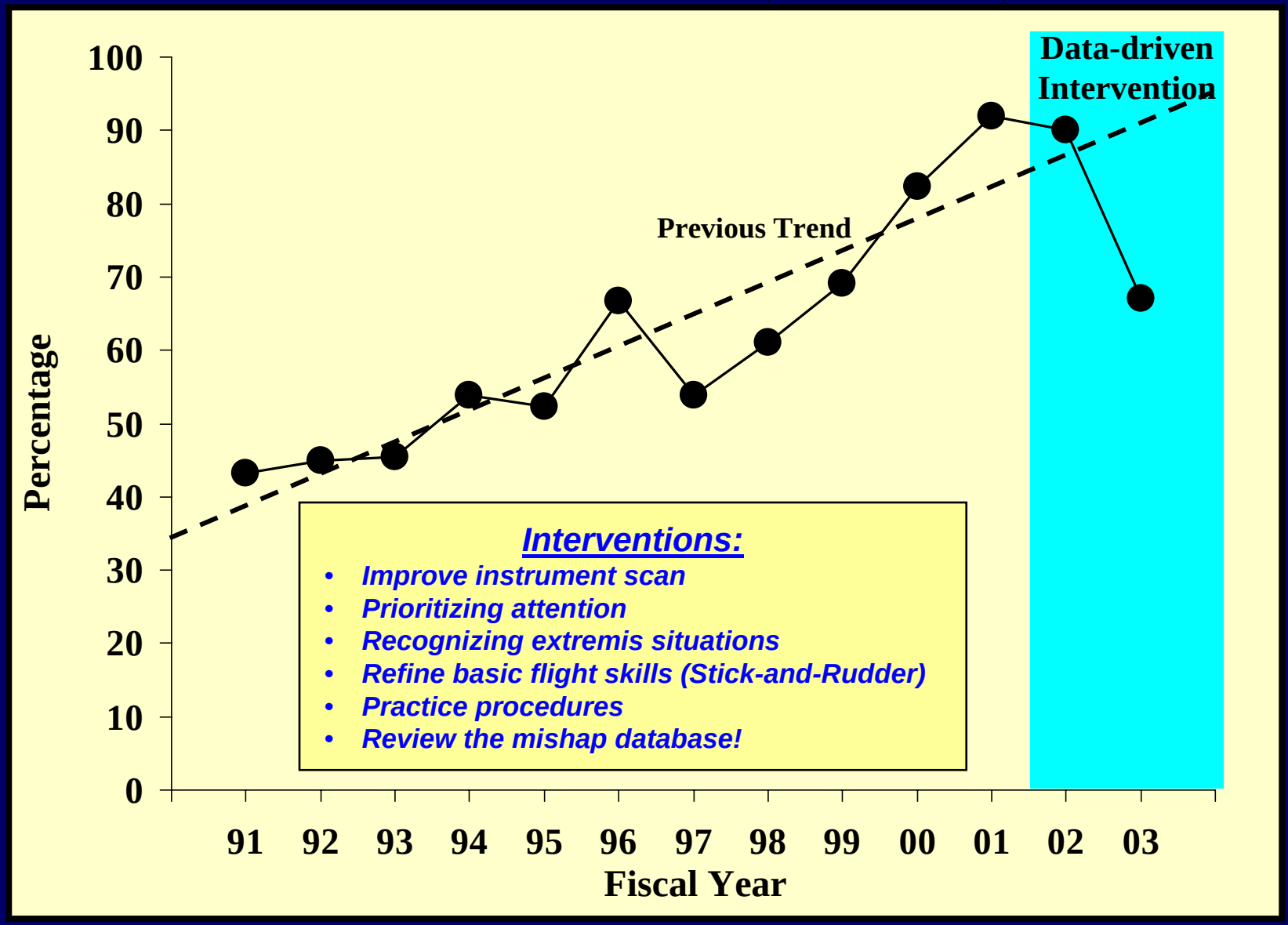
Tracking Human Factors Intervention Strategies

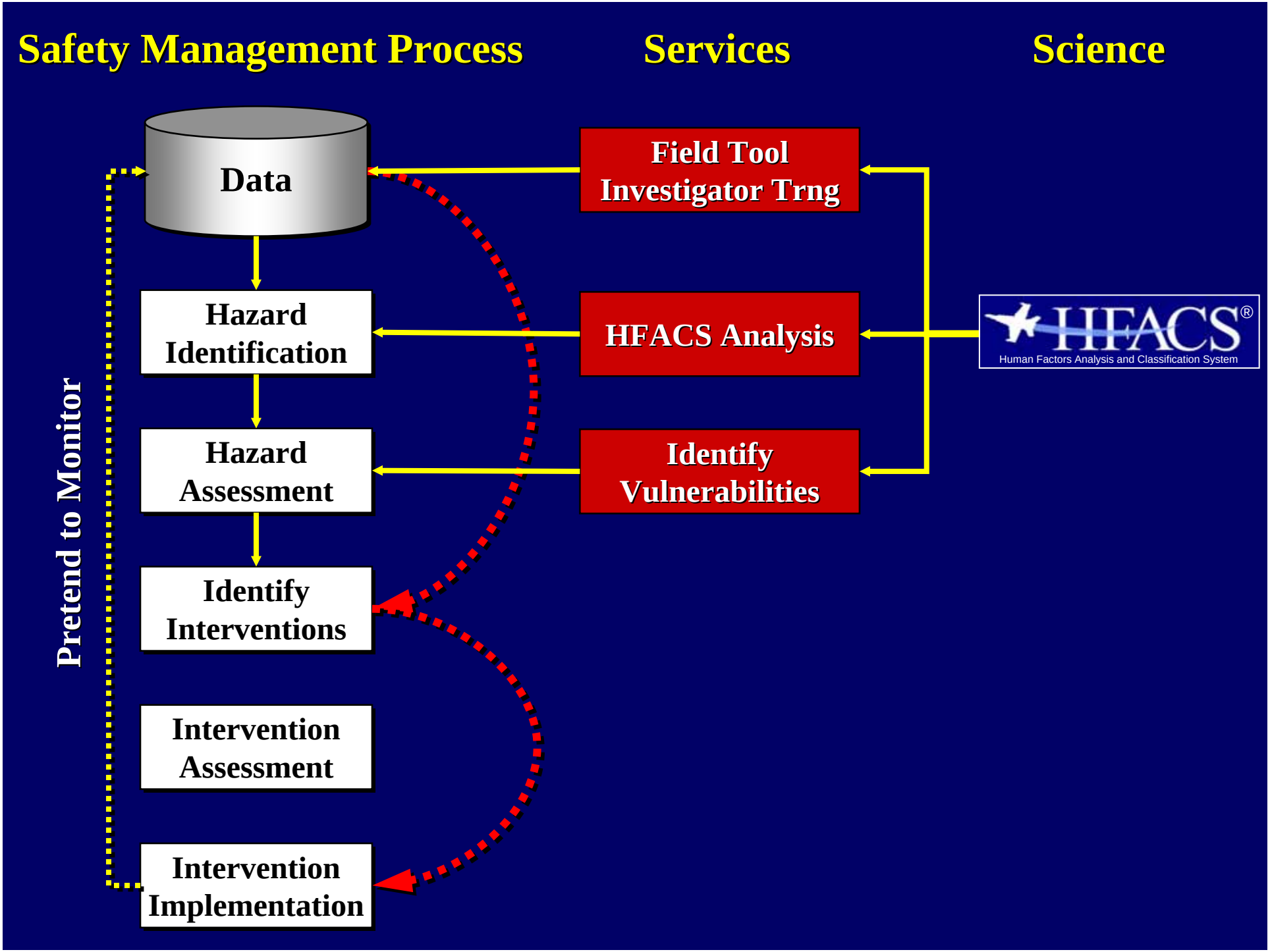


Percentage of Human Error Mishaps Associated with Decision Errors (FY 91-00)



Percentage of Human Error Mishaps Associated with Skill-based Errors (FY 91-03)




Safety Management Process
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Data
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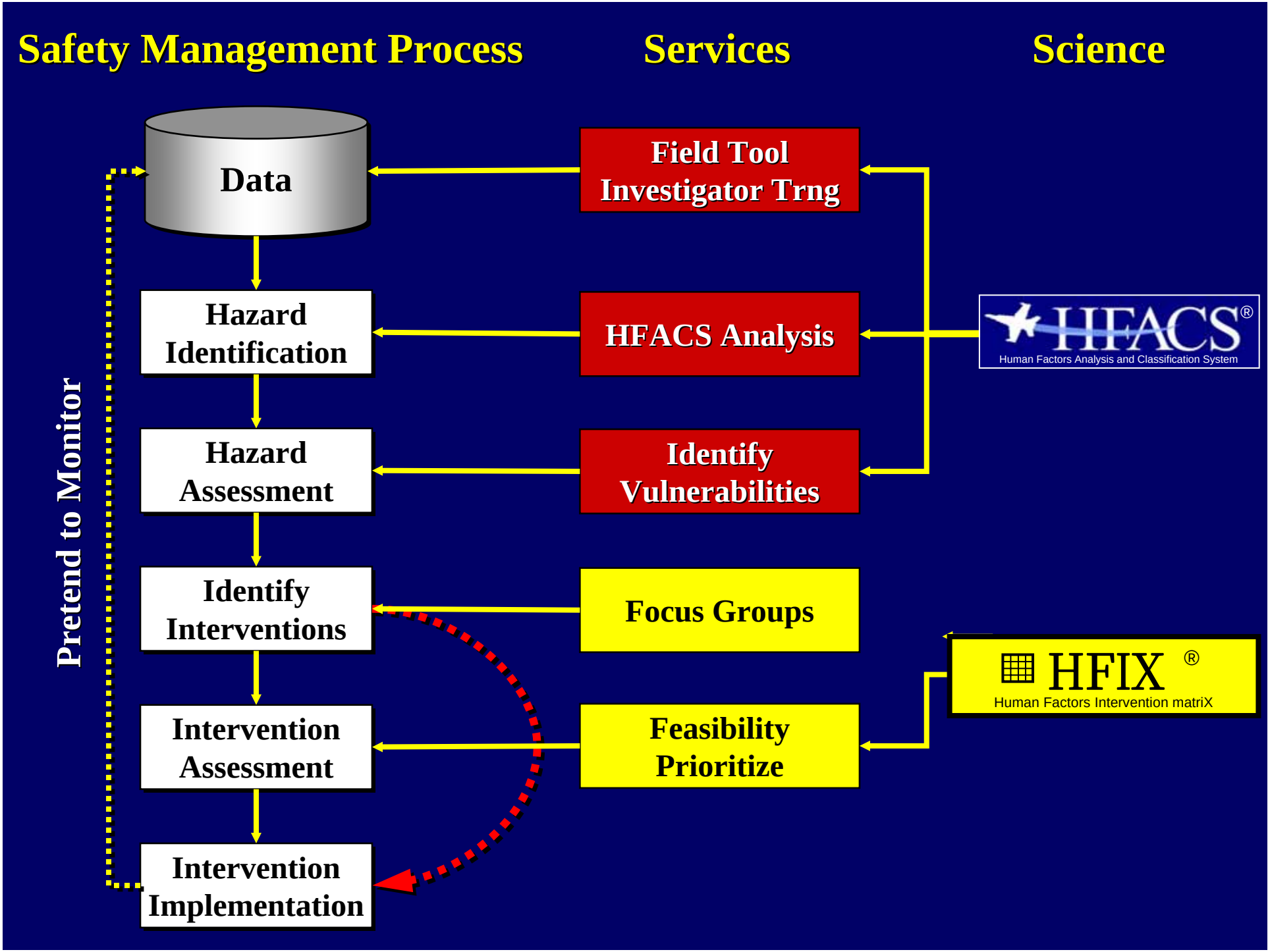
Hazard Assessment
Identify Interventions
Intervention Assessment
Intervention Implementation
Pretend to Monitor
Field Tool Investigator Trng
HFACS Analysis
Identify Vulnerabilities
HFACS®
Human Factors Analysis and Classification System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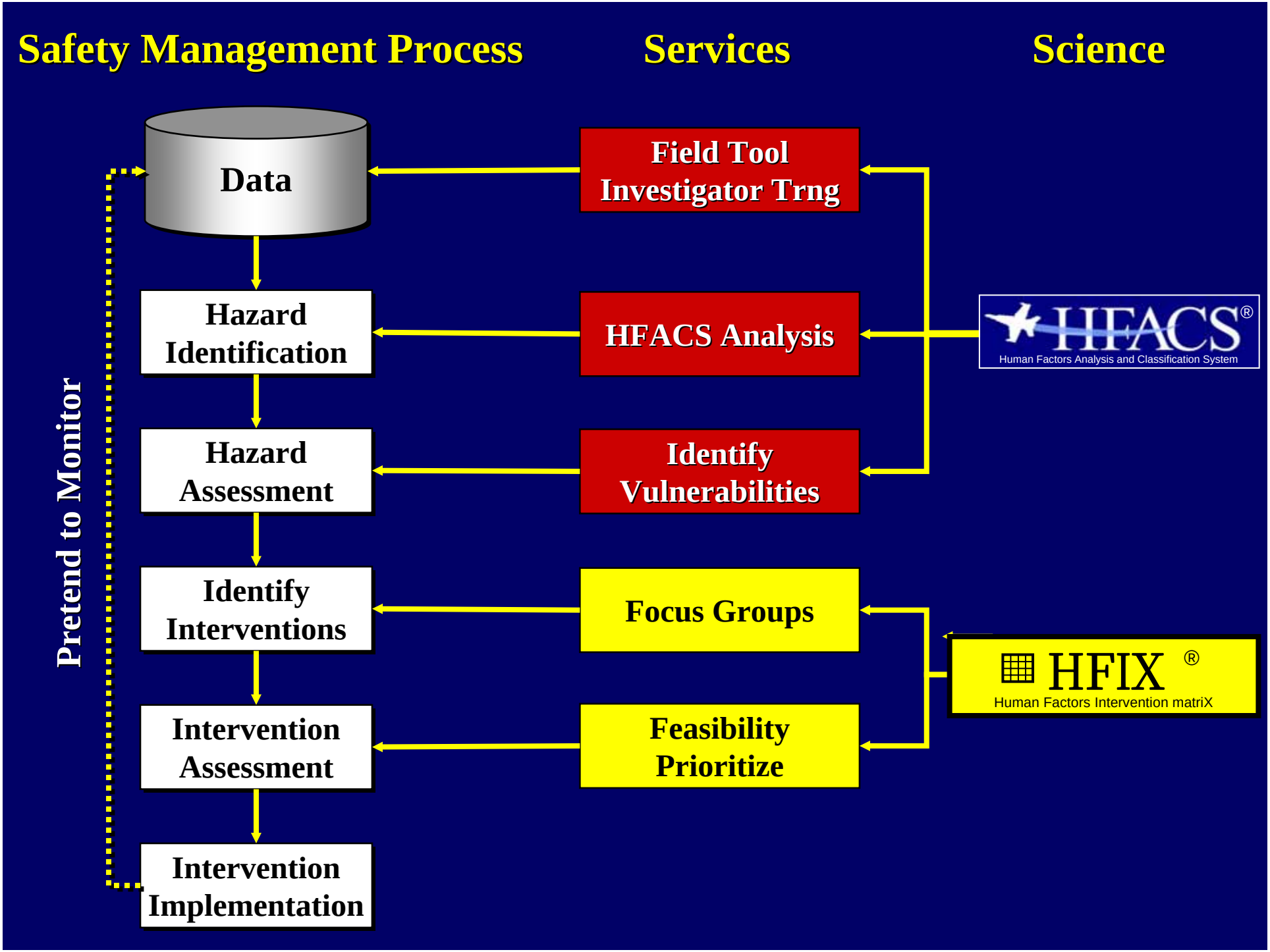
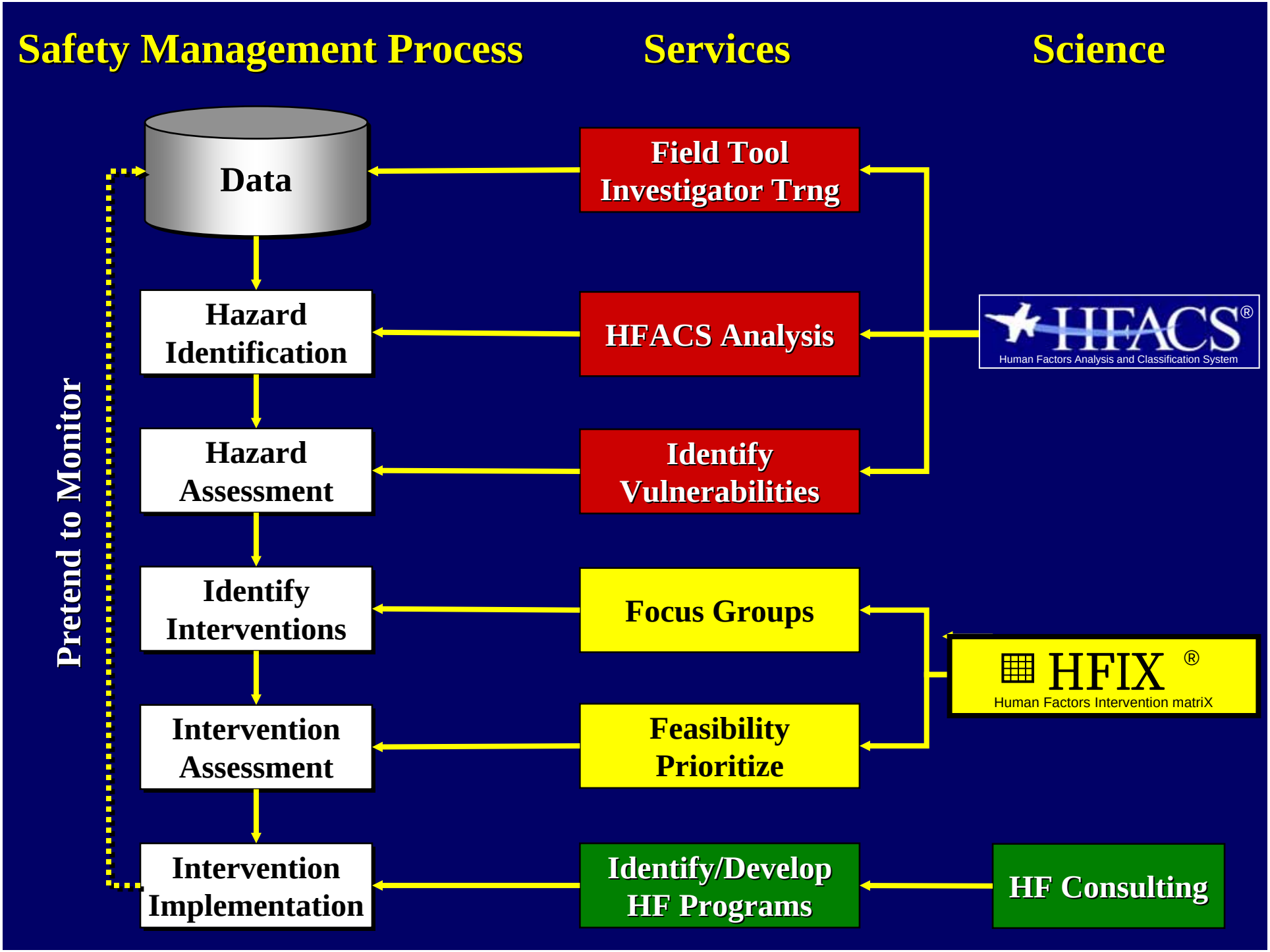
Focus Groups
Feasibility Prioritize
HFACS®
Human Factors Analysis and Classification System
HFIX®
Human Factors Intervention matriX


Safety Management Process
Services
Science
Data
Hazard Identification
Hazard Assessment
Identify Interventions
Intervention Assessment
Intervention Implementation
Pretend to Monitor
Field Tool Investigator Trng
HFACS Analysis
Identify Vulnerabilities
Focus Groups
Feasibility Prioritize
HFACS®
Human Factors Analysis and Classification System
HFIX®
Human Factors Intervention matriX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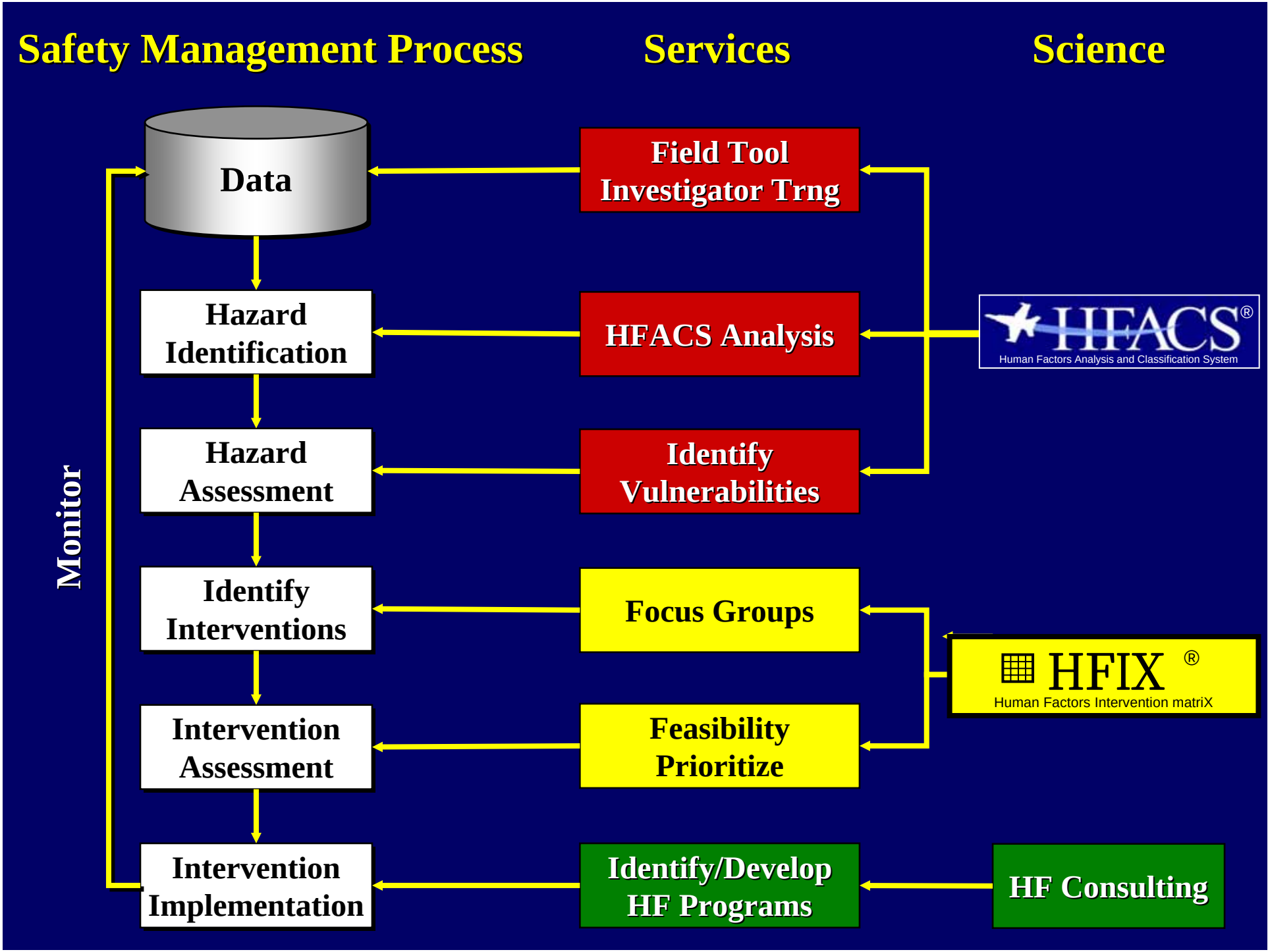
HFIX ®
Human Factors Intervention matriX
Intervention
Assessment
Feasibility
Prioritize
Intervention
Implementation
Identify/Develop
HF Programs
HF Consulting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Canadian Air Force

Royal Netherlands Air Force

Indian Air Force

Australian Government
Australian Transport Safety Bureau